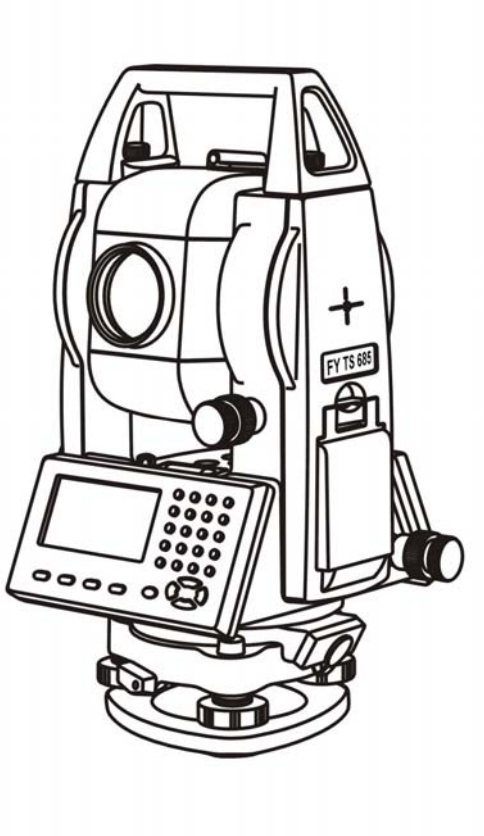
FUJIYAMA

FY TSO 682/685

FY TS 682/685

Total Station Instruction Manual



Version1.1e
English

Dear Customer:

Congratulations! We, FUJIYAMA are proud to present you with these series instrument. Your total station is a rugged and reliable instrument whose performance and design are not surpassed.

To fully appreciate and protect your investment, we suggest that you take the necessary time to read and fully understand this manual. We have a dedicated service organization. If the need arises, please don’t hesitate to contact us.

Thank you for your trust and confidence.

Contents

1. Precautions for Safety 1
1.1 Note 1
1.2 Definition of Indication 2
1.3 Safety Standards for Laser 3
1.4 About User 4
1.5 Exceptions from Responsibility 4
2. Preparation before Measurement 5
2.1 About Battery 5
2.1.1 Battery Power Symbol 5
2.1.2 Replace the Battery 6
2.1.3 Recharge the Battery 6
2.2 Setting-Up the Instrument 7
2.3 Centering and Levelling-Up 7
2.4 Accurate Levelling-Up with Electronic Level on screen 8
3. Basic Functions 9
3.1 Nomenclature 9
3.2 Basic Key Operation 11
3.3 Display 12
3.4 Mode Diagram 13
3.5 Power On/Off 14
3.6 How to Input Number and Alphabet 15
3.7 Setting Mode (Press {★} directly) 16
3.8 How to Set Parameters 17
3.8.1 Measurement Condition Setting 17
3.8.2 Instrument Basic Setting 18
3.8.3 Communication Port Setting 19
3.8.4 Unit Setting 20
3.8.5 Date & Time Setting 21
3.8.6 EDM Setting 22
4. Angle Measurement 23
4.1 Measure an Horizontal Angle of Two Points 23
4.2 Set the Horizontal Angle to a Required Value 23
5. Distance Measurement 24
6. Coordinate Measurement 26
6.1 Input the Occupied Point Data 28
6.2 Azimuth Setting 29
6.3 3D Coordinate Measurement 30

7. Stake out Measurement 30
7. 1 Distance Stake out 30
7.2 Coordinates Stake out Measurement 32
7.3 REM Stake out Measurement 33
8. Area 35
8.1 Area Calculation by Measured Data 35
8.2 Area Calculation by Reading Existed Coordinates 36
9. Offset Measurement 38
9.1 Single-distance Offset Measurement 38
9.2 Angle Offset Measurement 39
9.3 Dual-distance Offset Measurement 41
10. MLM 43
10.1 Measuring Distance Between Two or More Points 43
10.2 Change the Starting Point 44
11. REM 45
12. Resection 46
12.1 Coordinate Resection 47
12.2 Elevation Resection 48
12.3 Resection Calculation Process 50
12.4 Precautions When Performing Resection 51
13. Point Projection 52
13.1 Define Baseline 52
13.2 Point Projection 54
14. Stake Out Line 55
14. 1 Define Baseline 55
14. 2 Stake Out Line-Point 57
15. Traverse Surveying 59
15.1 Save Coordinate 59
15.2 Read Coordiante 60
16. Inverse 61
17. Polar Coordinates Calculation 63
18. Record 64
18.1 Record Occupied Data 64
18.2 Record Angle Data 65
18.3 Record Distance Data 66
18.4 Record Coordinate Data 66
18.5 Record Distance&Coordinate Data 67
18.6 Record Note 68

18.7 View Data 69
19. JOB Management 70
19.1 Select a JOB 70
19.2 Rename a JOB 71
19.3 Outputing JOB Data 72
19.4 Output JOB Data 73
19.4.1 Download Data 73
19.4.2 Instruction of Office Software 74
20. Known Data Management 75
20.1 Input Known Point Coordinate by Keys 75
20.2 Input Known Point Coordinate via RS-232C 76
20.3 Delete known point coordinate 76
20.4 View known points data 77
20.5 Clear all known points data 78
21. Code Management 79
21.1 Input a Code 79
21.2 Delete a Code 80
21.3 View All Codes 80
21.4 Clear all Codes 81
22. Warning and Error Messages 82
23. Checks and Adjustment 83
23.1 The Instrument Constant 83
23.2 Plate Level 84
23.3 Circular Level 84
23.4 The Optical Sight 85
23.5 Optical Plummet 85
23.6 Laser Plummet (optional) 86
23.7 Vertical Cross-hair on Telescope 86
23.8 Horizontal Collimation Error C 87
23.9 Tilt Sensor 88
23.10 Vertical Index Error 89
23.11 EDM Optical Axis and the Telescope Sighting Axis Error 91
24. Specifications 93
25. Accessories 95
Appendix I: Atmospheric correction formula and chart (Just for reference) 99
Appendix II: Correction for refraction and earth curvature 1001

1. Precautions for Safety

1.1 Note

◆ **Don’t collimate the sun directly**

Avoid to insolate the instrument, and don’t collimate the sun directly for protecting eyes and instrument.

◆ **Avoiding the librations on the instrument**

When transporting, keep the instrument in the case and try your best to lighten librations.

◆ **Carry the instrument**

When carrying，the instrument handle must be hold tight.

◆ **Check the battery power**

Before using it, you should check the power whether it is enough.

◆ **Take out the battery**

It is not suggested to take out the battery when the instrument is on, otherwise, the stored data may be lost, so it is better to replace the battery after power off the instrument.

◆ **Set up the instrument on the tripod**

When using it please insure the connection between tripod and instrument is firm. It is better to work with wooden tripod for the measurement accuracy.

◆ **Assemble the tribrach on the instrument**

The setting of tribrach would influence the accuracy. The tribrach should be check frequently, the screw which connects the tribrach and alidade must be locked tightly. And the central fixing screw should be tight.

◆ **High temperature condition**

Don’t put the instrument in high temperature condition for a long time, it is bad for the instrument performance.

◆ **Temperature changing sharply**

The sharp temperature changing on the instrument or prism will shorten the distance measurement range, for example, after taking the instrument out from a warm car to a cold condition, wait for some time, it can be used when it adapts the surrounding condition.

◆ **The noise from the instrument**

When the instrument working, it is normal if you hear the noise from instrument motor, it will not affect the instrument work.

◆ **Stored data responsibility**

FUJIYAMA should not be held liable for the lost data because of wrong operation.

1.2 Definition of Indication

For the safe of your product and prevention of injury to operators and other persons as well as prevention of property damage, items which should be observed are indicated by an exclamation point within a triangle used with WARNING and CAUTION statements in this manual.

The definitions of the indication are listed below. Be sure you understand them before reading the manual's main text.

⚠ WARNING:	Ignoring this indication and making an operation error could possibly result in death or serious injury to the operator.
⚠ CAUTION:	Ignoring this indication and making an operation error could possibly result in personal injury or property damage.

⚠ WARNING

- Do not perform disassembly or rebuilding. Fire, electric shock or burns could result. Only FUJIYAMA authorized distributors can disassemble or rebuilt.
- Do not collimate the sun directly. The eye injury or blind could result.
- Do not cover the charger. Fire could be result.
- Do not use defection power cable, socket or plug. Fire, electronic shock could result.
- Do not use wet battery or charger. Fire, electronic shock could result.
- Do not close the instrument to burning gas or liquid, and do not use the instrument in coal mine. Blast could be result.
- Do not put the battery in the fire or high temperature condition. Explosion, damage could result.
- Do not use the battery which is not specified by FUJIYAMA. Fire, electric shock or burn could result.
- Do not use the power cable which is not specified by FUJIYAMA. Fire could result.
- Do not short circuit of the battery. Fire could result.

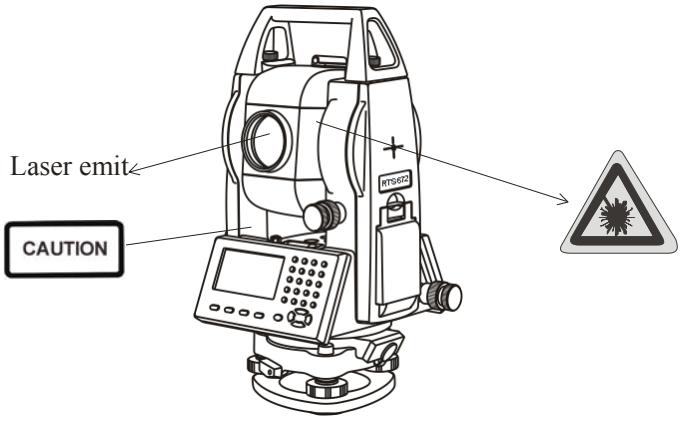
⚠ CAUTION

- Do not touch the instrument with wet hand. Electric shock could result.
- Do not stand or seat on the carrying case, and do not turn over the carrying case arbitrarily, the instrument could be damaged.
- Be careful of the tripod tiptoe when setup or move it.
- Do not drop the instrument or the carrying case, and do not use defective belt, agraffe or hinge. Instrument damage could result.
- Do not touch liquid leaking from the instrument or battery. Harmful chemicals could cause burn or blisters.
- Please assemble the tribrach carefully, if the tribrach is not stable, series damage could result.
- Do not drop the instrument or tripod, series damage could result. Before use it, check the central screw is tight.

1.3 Safety Standards for Laser(Only for FY TSO 682/685)

FY TSO 680 series adopt the class of Laser Product according to IEC Standard Publication 60825-1 Amd. 2:2001. According this standard, EDM device is classified as Class 3R Laser Product when reflectless measurement is selected, when the prism and reflective sheet is selected as target, the output is equivalent to the safer class 1. Follow the safety instructions on the labels to ensure safe use.

CAUTION: CLASS 3R LASER RADIATION WHEN OPEN
AVOID DIRECT EYE EXPOSURE.
CAUTION: CLASS 2 LASER RADIATION WHEN OPEN
DO NOT STARE INTO THE BEAM



Note for Safety

⚠ WARNING
● Never point the laser beam at other's eyes, it could cause serious injury. ● Never look directly into the laser beam source, it could cause permanent eye damage. ● Never stare at the laser beam, it could cause permanent eye damage. ● Never look at the laser beam through a telescope or other optical devices, it could cause permanent eye damage.

1.4 About User

1) This product is for professional use only!
The user is required to be a qualified surveyor or have a good knowledge of surveying, in order to understand the user manual and safety instructions, before operating, inspecting or adjusting.

2) Wear required protectors (safety shoes, helmet, etc.) when operating.

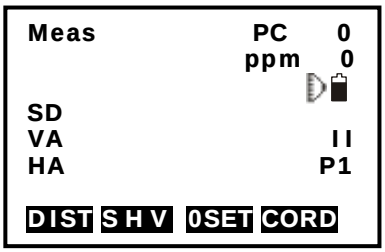
1.5 Exceptions from Responsibility

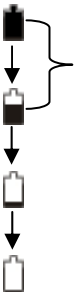
1) The user of this products is expected to follow all operating instructions and make periodic checks of the product's performance.
2) The manufacturer, assumes no responsibility for results of a faulty or intentional usage or misuse including any direct, indirect, consequential damage, and loss of profits.
3) The manufacturer, assumes no responsibility for consequential damage, and loss of profits by any disaster, (an earthquake, storms, floods etc.).
4) The manufacturer, assumes no responsibility for any damage, and loss of profits due to a change of data, loss of data, an interruption of business etc., caused by using the product or an unusable product.
5) The manufacturer, assumes no responsibility for any damage, and loss of profits caused by usage except for explained in the user manual.
6) The manufacturer, assumes no responsibility for damage caused by wrong transport, or action due to connecting with other products.

2. Preparation before Measurement

2.1 About Battery

2.1.1 Battery Power Symbol





Measurement is possible

The battery is lower, it is better to replace or recharge it

Measurement is impossible, it is necessary to replace or recharge battery

NOTE:

◆ The working time of battery will be effected by many factors, such as ambient temperature, recharging time, recharging and discharging times. On the data safe side, we suggest the users recharge the battery full or prepare several full batteries before operation.

◆ The battery symbol only indicates power capability for current measurement mode. The power consumption in distance measurement mode is more than in angle mode, if the instrument enters into distance measurement mode from angle mode, the power maybe auto-off because of lower battery.

◆ The symbol only indicates the supply power but not the instantaneous power change. And if the measurement mode changes, the symbol will not show the power's decrease or increase immediately.

◆ It is suggested to check every battery power before field work.

2.1.2 Replace the Battery

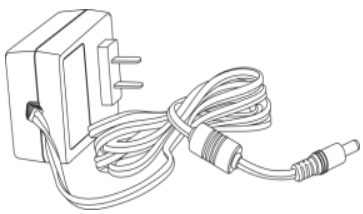
1) Remove the battery

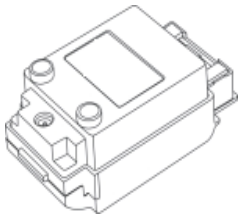
① Press the button downward as shown left
② Remove the battery by pulling it toward you

2) Mount the battery

① Insert the battery to the instrument
② Press the top of the battery until you hear a Click.

2.1.3 Recharge the Battery





As above figures show, connect the charger and the battery, then plug the charger into the outlet of 110V-220V AC power supply, recharging will begin.

NOTE:

◆ For a new (or long time no use) battery, in order to fully extend its capacity, it is absolutely necessary to carry out 3 to 5 complete charging/discharging cycles, and the charging time must be 10 hours at least each time.

◆ The indicator light on the charger will illuminate three separate colors for varies mode conditions:

Solid Red Light—indicates that the charger is working;

Solid Green Light— indicates that the charge has finished;

Flashing Red Light—indicates no battery on charging, poor connection or some problems exist.

◆ It is recommended to continue charging for 1 or 2 hours after the light turn green.

◆ Once the red light flashes constantly after the charger is plugged into the outlet of 110V-220V AC power supply, please remove the battery and reconnected it after 3 or 5 min.

2.2 Setting Up the Instrument

Mount the battery in the instrument before performing this operation because the instrument will tilt slightly if the battery is mounted after leveling.

I. Set up the tripod first: extend the extension legs to suitable lengths and tighten the screws on the midsections. Make sure the legs are spaced at equal intervals and the head is approximately level. Set the tripod so that the head is positioned over the surveying point. Make sure the tripod shoes are firmly fixed in the ground.

II. Mount the instrument on the tripod head. Supporting it with one hand, tighten the centering screw on the bottom of the unit to make sure it is secured to the tripod.

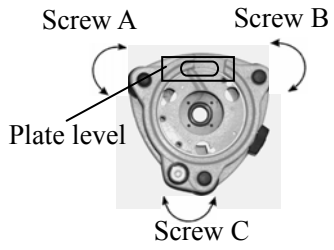
2.3 Centering and Levelling-Up

1. Position tripod legs so that the plummet is aimed to the ground mark point. Turn the focusing ring of the optical plummet to focus.

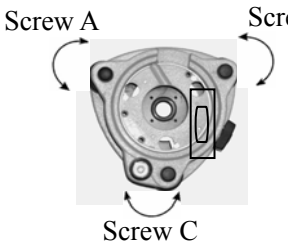
2. Turn three footscrews of the tribrach till the center of reticle exactly coincides with the surveying point in any position.

3. Move the tripod legs to centre the circular level. The instrument is now roughly leveled-up.

4. Center the bubble in the circular level



Loosen the horizontal motion clamp, and turn the instrument till the plate level is perpendicular to a line shaped with screws A and B. Adjust the screws A and B to make the bubble in the center of the level.



Turn the instrument approximately 90° . Adjust screw C, till the bubble in the center of the level.

Repeat above steps until the bubble remains in the center of the plate level while the instrument is rotated to any position.

4. Center the surveying point again

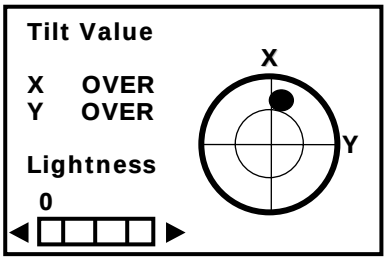
Loosen the centering screw slightly. Looking through the optical plummet eyepiece, slide the instrument over the tripod head until the surveying point is exactly centered in the reticle. Re-tighten the centering screw securely.

5. Check again to make sure the bubble in the plate level is centered.

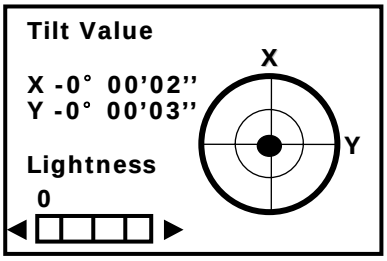
If not, repeat procedure 4.

2.4 Accurate Levelling-Up with Electronic Level on screen

It is convenient for 680 series to level-up with electronic level, especially when it is difficult to observe the circular level and plate level.



1. Power on the instrument and enter into measurement mode, press F1: [**TILT**] at P3 or press key {BS} directly, and the electric level displays on screen.

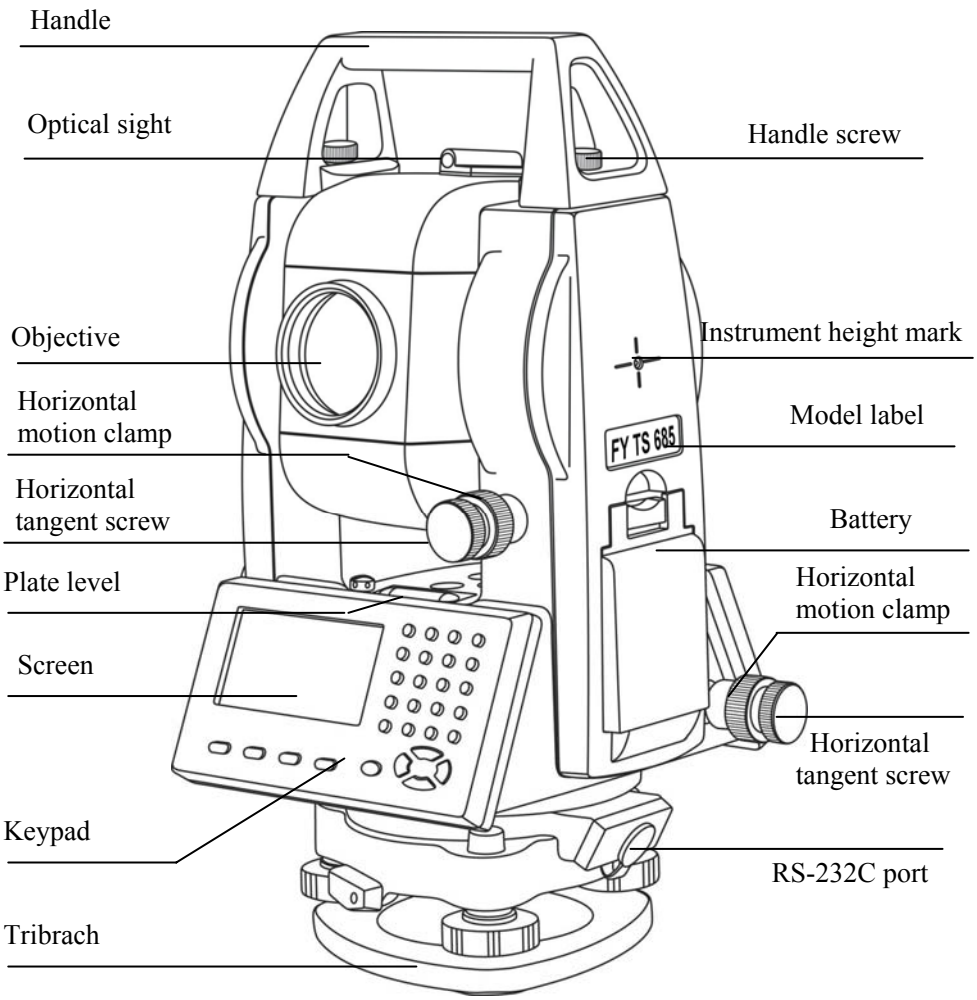


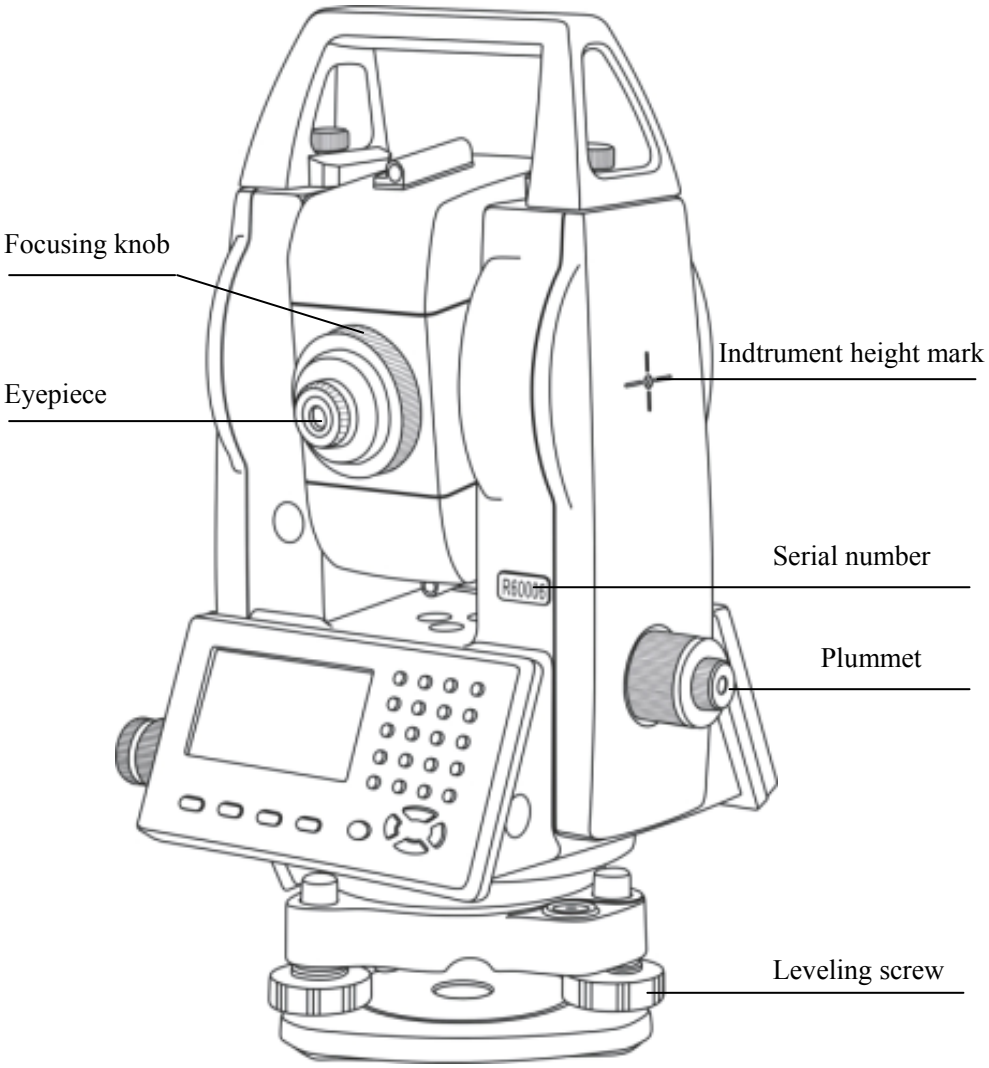
2. Level it by turning three foot screws, see above operation "3. Center the bubble in the plate level". Be sure the ● is always in the center.

Note: If the instrument is equipped with laser plummet, after opening this menu, the laser plummet will turn on automatically. With pressing ◄ or ► key the laser lightness can be adjusted.

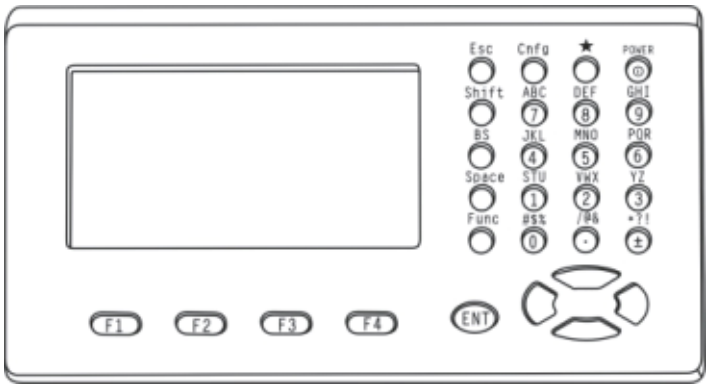
3. Basic Functions

3.1 Nomenclature




Focusing knob
Eyepiece
Indtrument height mark
Serial number
Plummet
Leveling screw

3.2 Basic Key Operation

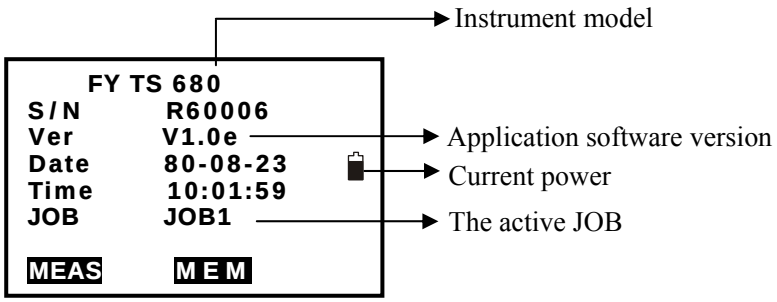


Keys	Description
F1~F4	Select the functions matching the softkeys
0~9	1.Input number when numeric input 2.Input characters when alphabetic input
•	Input a decimal point
±	Input plus/minus sign
Power	Power on/off
★	Enter into setting mode directly
Cnfg	Enter into config mode directly
ESC	Escape to the previous menu or mode
Shift	1. Shift between number and alphabetic when inputting 2.Shift targets model when measuring
BS	Delete the character at the left of the cursor when inputting
Space	1. Input a black space when inputting 2. Input the target height
Func	Turn page
ENT	1. Select/Accept input data 2. Accept the option when selecting

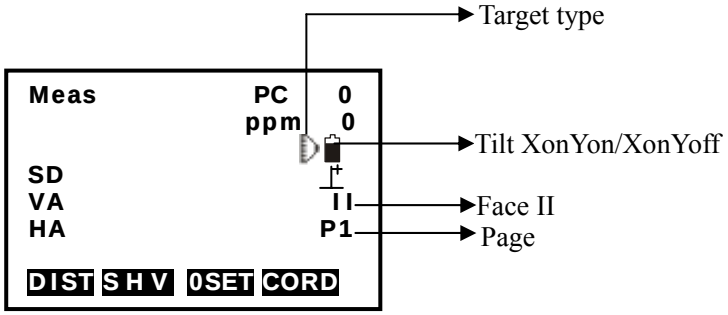
3.3 Display

The LCD could display 8 lines with 24 characters per line. In measurement mode, it displays some common information in above 5 lines and displays soft functions in the last line.

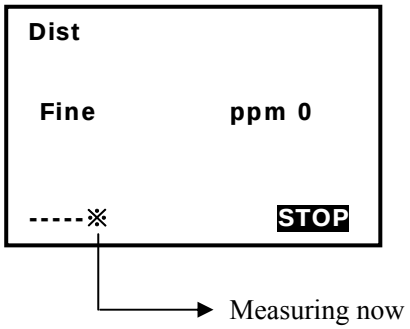
Status screen



Measure mode

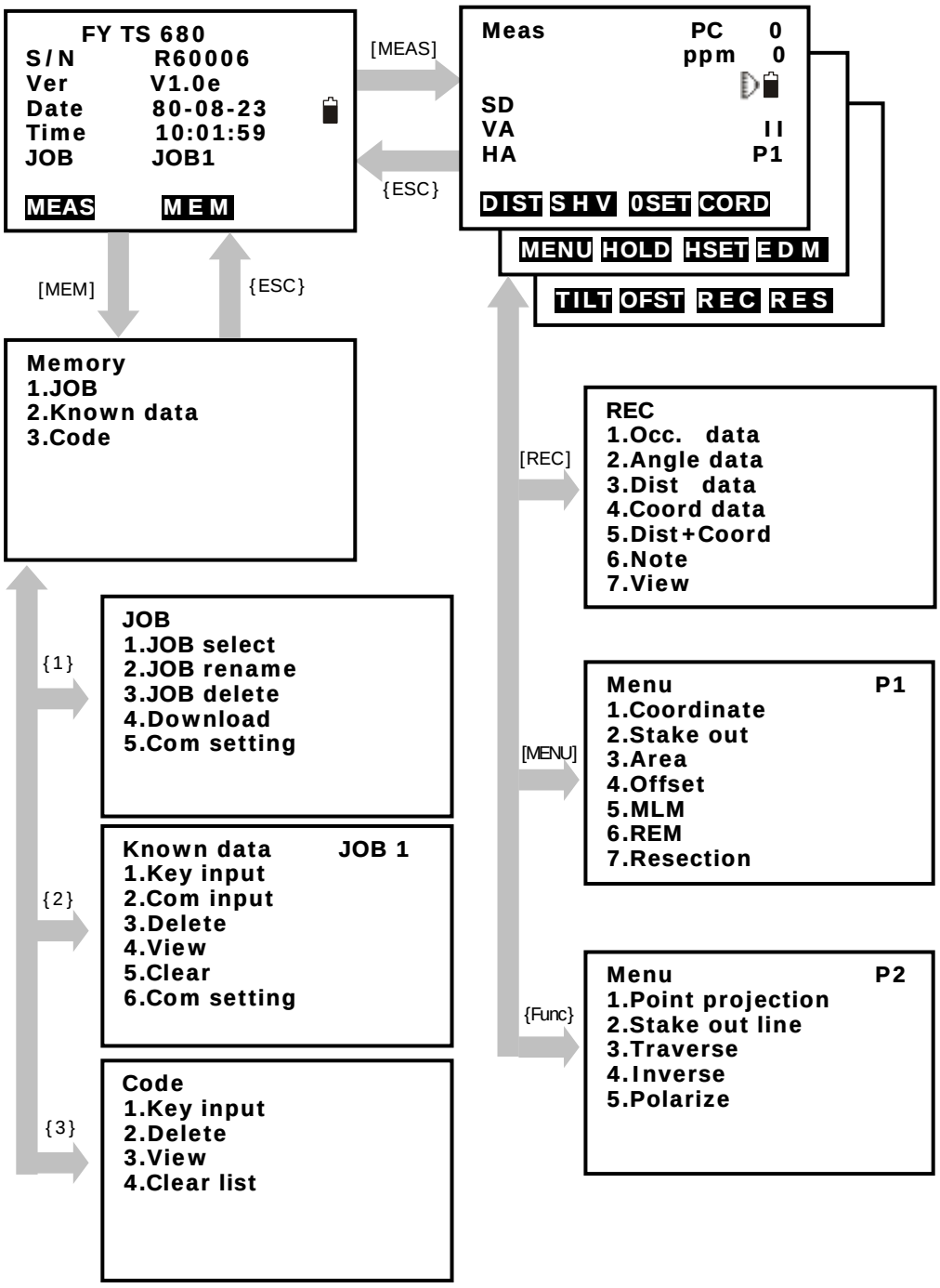


Measuring

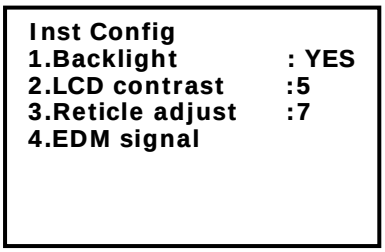


3.4 Mode Diagram

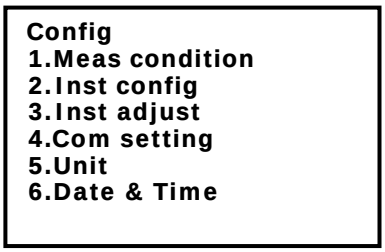
Meas mode



Setting mode (Press {★} directly)

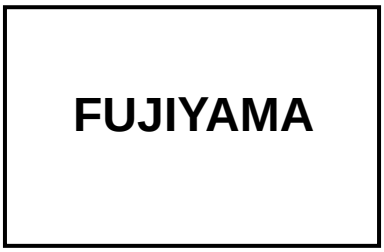


Config mode (Press {Cnfg} directly)

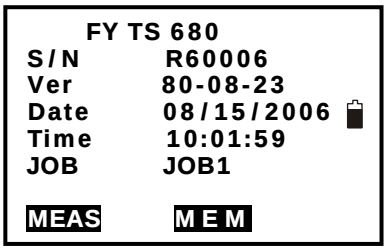


3.5 Power On/Off

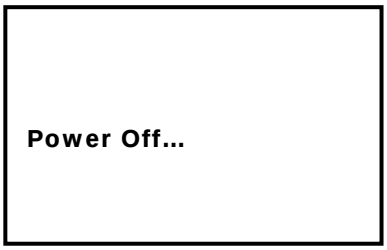
I. Power on



1. Confirm the instrument is leveling, press the red key {POWER}.



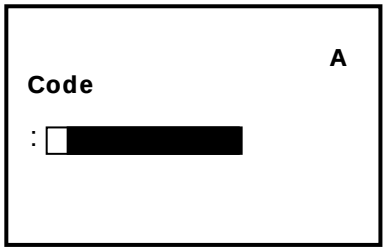
2. The instrument power on and display "FUJIYAMA", then it will display the status screen automatically.



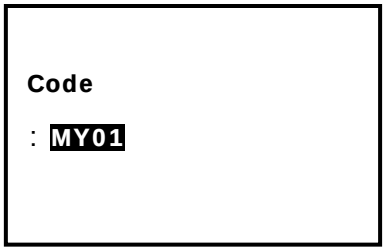
II. Power off

Press the key {POWER} and hold for 4 seconds, the instrument will be off after beep.

3.6 How to Input Number and Alphabet



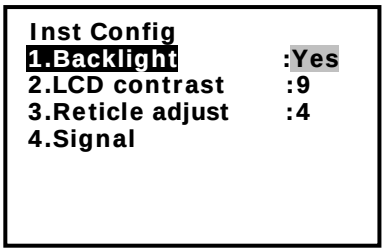
1. Enter into input code status (See § 21.1 Input a code), the cursor is blinking and ready to input. The note “A” at the top right corner shows the active input mode, you can press the key {shift} to switch between alphabet and number.



2. Input the code in turn and press the blue key {ENT} to save it. You can press key {BS} to delete your wrong input before the cursor. The max length of a code is 16 characters.

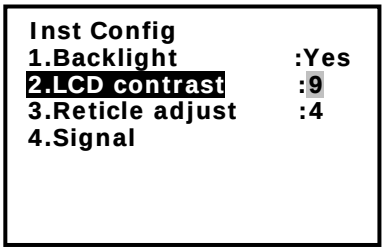
3.7 How to Configure

Press key {★} on panel directly to enter into in any status, and do some basic settings.



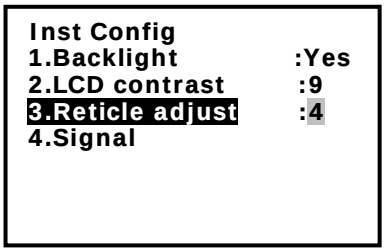
1. Backlight

Press numeric key {1}, then press left key { ▶} or right key { ◀} to turn on or not.



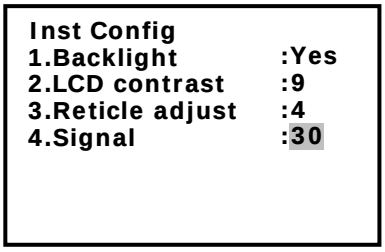
2. LCD contrast

Press numeric key {2}, then press left key { ▶} or right key { ◀} to adjust it.



3. Reticle level

Press numeric key {3}, then press left key { ▶} or right key { ◀} to adjust it. If the value is zero, the illumination is turned off.



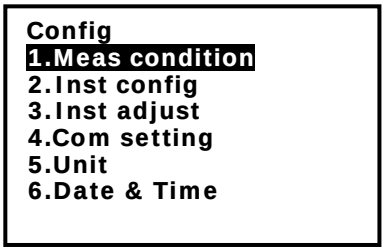
4. Signal

Aim at a target, then press numeric key {4} and the instrument will beep, the EDM returned signal value will display simultaneously.

3.8 How to Set Parameters

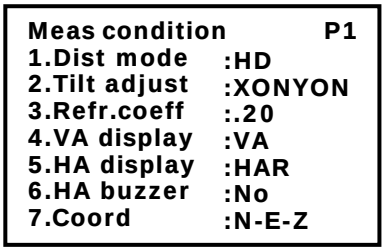
Press key {Cnfg} on the keyboard to enter into config mode in any status, all the following items can be set.

3.8.1 Measure Condition Setting



1. Press key {Cnfg} to enter into config mode.

2. Select "**1.Meas condition**" to set measurement parameters. All items display on two pages.



3. Change the settings if necessary. Press keys { ▲}/ {▼} to select items and press keys {◀ }/ { ▶} to set options.

4. Press key {ESC} back to the previous mode.

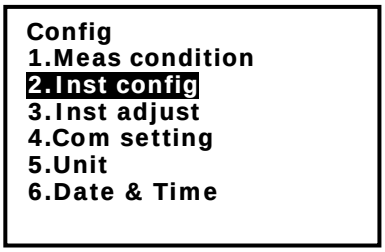
Table 3-1 List of measurement condition setting

Item	Options
1.Dist mode	SD * /HD/VD
2.Tilt adjust	XonYon * /XonYoff/XoffYoff
3.Refr.coeff	.14 * /.20/No
4.VA display	Zenith * /VA/V90/Grade
5.HA display	HAR * /HAL
6.HA buzzer	No * /Yes
7.Coord	N-E-Z * /E-N-Z
1.Min reading	1″ * /5″ /10″ ; 0.0002g * /0.001g/0.002g; 0.005mil * /0.02mil/0.05mil
2.ppm correct	No * /Yes (auto correct ppm or not by built-in temperature and pressure sensors)

NOTE:

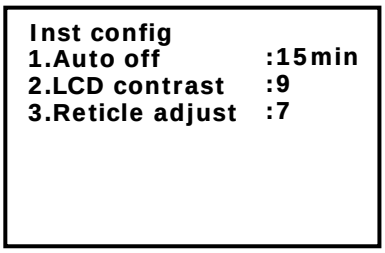
◆ Every first options with the symbol " * " are the factory setting.

3.8.2 Instrument Basic Setting



1. Press key {Cnfg} to enter into config mode.

2. Select "**2.Inst config**" to set instrument basic parameters. Three items display.



3. Change the settings if necessary. Press keys {▲}/ {▼} to select items and press keys {◄}/ {►} to set the options.

4. Press key {ESC} back to the previous mode.

Table 3-2 Option list of basic setting

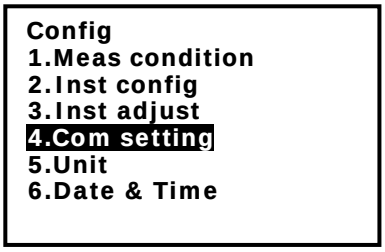
Item	Options
1.Auto off	30min * /No/5min/10min/15min (The instrument would power off automatically to save battery if no operation in setting time)
2.LCD contrast	0~13 (9 *)
3.Reticle adjust	0~9 (7 *)

NOTE:

◆ The options with the symbol " * " are the factory setting.

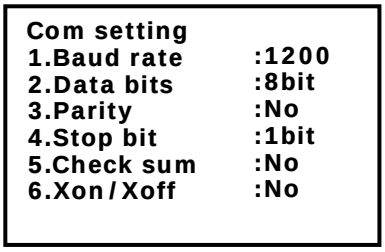
3.8.3 Communication Port Setting

Please set communication parameters before connecting your computer.



1. Press key {Cnfg} to enter into config mode.

2. Select "**4.Com setting**" to set the parameters of communication port.



3. Change the settings if necessary. Press keys {▲}/ {▼} to select items and press keys {◄} / {►} to set the options.

4. Press key {ESC} back to the previous mode.

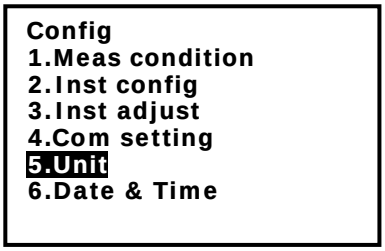
Table 3-3 Option list of com setting

Item	Options
1.Baud rate	1200 * /2400/4800/9600/19200/38400
2.Data bits	8bit * / 7 bit
3.Parity	No * / Even/ Odd
4.Stop bit	1bit * / 2bit
5.Check sum	No * / Yes
6.Xon/Xoff	No * / Yes

Note:

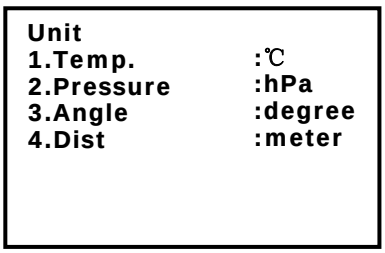
◆ Every first options with the symbol " * " are the factory setting.

3.8.4 Unit Setting



1. Press key {Cnfg} to enter into config mode.

2. Select "**5.Unit**" to set unit.



3. Change the settings if necessary. Press keys {▲}/ {▼} to select items and press keys {◀} / {▶} to set the options.

4. Press key {ESC} back to the previous mode.

Table 3-4 Option list of unit setting

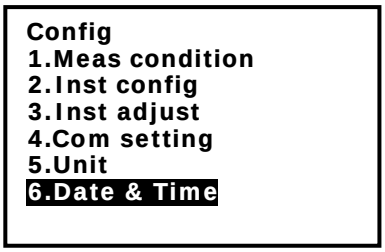
Item	Options
1.Temp.	℃ * / ℉
2.Pressure	hPa * / mmHg / inchHg
3.Angle	degree * / gon / mil
4.Dist	meter * / Us-feet/Int-ft

Note:

◆ Every first options with the symbol " * " are the factory setting.

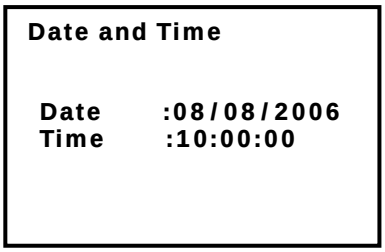
3.8.5 Date & Time Setting

The date and time displays at the status mode.



1. Press key {Cnfg} to enter into config mode.

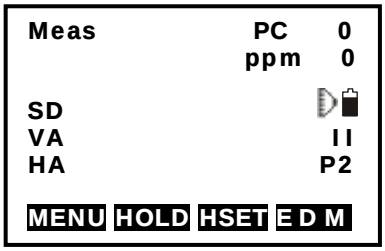
2. Select "**6.Date & Time**".



3. Input date and time. The date format: month/date/year.

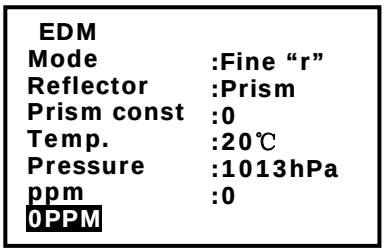
4. Press key {ENT} to save settings and back to the previous mode.

3.8.6 EDM Setting



1. Press F1: [**MEAS**] in the status mode to enter into measure mode.
   Press key {Func} to turn to page P2.

2. Press F4: [**EDM**] to enter into EDM setting.



3. Change the settings if necessary. Press keys {▲}/ {▼} to select the first three items and press keys {◄} / {►} to set the options.

4. Press key {ESC} back to the previous mode.

Table 3-5 EDM setting

Item	Options
1.Mode	Fine "r" * / FineAVG 3 / Fine "s" / Rapid "s" / Tracking
2.Reflector	Prism * / Sheet/ No prism
3.Prism const	-99~99
4.Temp.	-30～60℃ (20℃ *)/-22～140℉
5.Pressure	500～1400hPa (1013hPa *) ; 375～1050mmHg (760mmHg *) ; 14.8～41. 3 inchHg (29.9inchHg *)
6.ppm	-499～499 (0 *) , Press F1: [**0PPM**] to set temperature, pressure and ppm as factory setting.

Note:

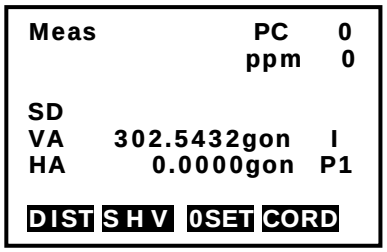
◆ Options with the symbol " * " are the factory setting.

◆ ppm value could be calculated by inputted temperature and pressure, or input directly. If the option of "ppm correct" is set as "Yes", the temperature, pressure and ppm can not be inputted by hand.

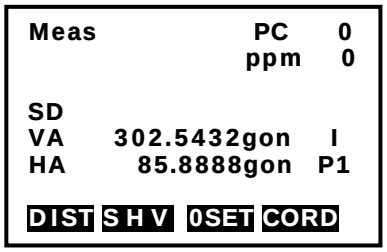
◆ This operation is also available in stake out mode.

4. Angle Measurement

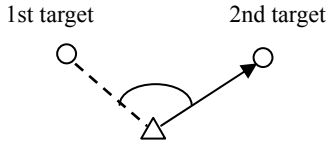
4.1 Measure a Horizontal Angle of Two Points



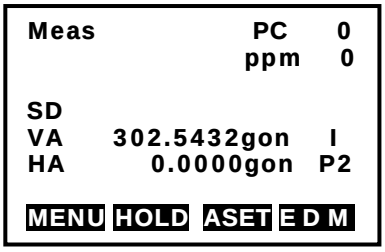
1. Sight the 1st target.
   Press F3: [**0SET**] twice to set the 1st target as 0° at P1 in the measure mode.
   Press [**SHV**] firstly if in distance mode.



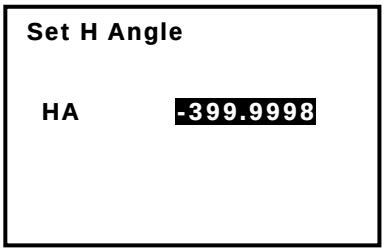
2. Sight the 2nd target. The displayed value is the included angle between two points.



4.2 Set the Horizontal Angle to a Required Value

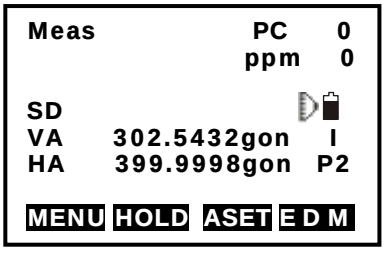


1. Take your instrument sight the 1st target.
   Press F3: [**ASET**] at P2 in the measure mode.



2. Input the required value, then press {ENT} to save the value. And it displays as the horizontal angle.
The range and format of the input value:
   gon: 0~399.9999
   degree: 0~359.5959
   mil: 0~6399.999

3. Sight the 2nd target. The horizontal angle from the 2nd target to the value set as the horizontal angle is displayed.



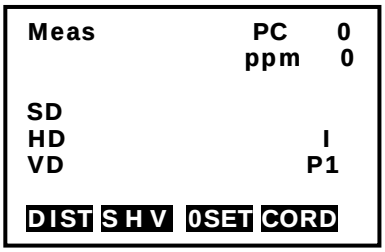
NOTE: Pressing [**HOLD**] performs the same function as above. The horizontal angle is in hold status when [**HOLD**] is flashing. Press [**HOLD**] again to releasse the hold status.

5. Distance Measurement

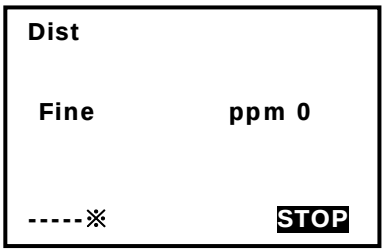
Please set the following items before distance measurement:

- Measurement condition (See § 3.8.1 Measure Condition Setting)
- EDM (See § 3.8.6 EDM setting)

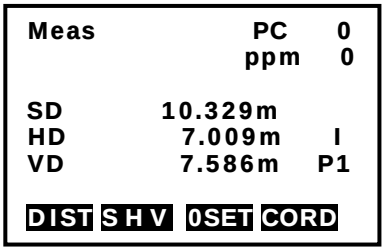
【Procedure of distance measurement】



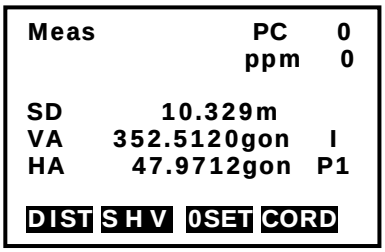
1. Aim at the target. Press F1: [**DIST**] at P1 in the measure mode.



2. The symbol "✱" moves continually when measuring distance. Distance measuring mode, prism const and ppm value are also presented.



3. Press F4: [**STOP**] to finish measurement. The "SD","HD", and"VD" will display as shown left.



4. Press F2: [**SHV**], SD/HD/VD and SD/VA/HA are displayed alternatively.

NOTE:

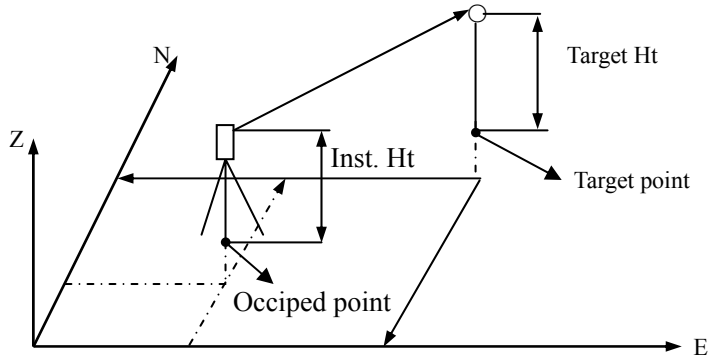
- ◆ Make sure that the target setting in the instrument matches the type of target used.
- ◆ If the objective lens is dirty, it will affect the accurate of measured results. Dust it off with your special brush and wipe it with your special cloth (in your carrring case)

before putting away.

- If an object with a high reflective factor (metal, white surface) exists between the instrument and the target when measuring, the accuracy of the measured results will be affected.
- An angle is also able to be measured when distance measurement.
- Measurement will automatically stop after a single measurement if the EDM mode is single (Fine “S” / Rapid “S”).
- If the distance measurement mode is average “Fine AVG”, the measured distances are displayed as “-1”,”-2”,”-3”…”-9” in turn, and the average value will display behind “-A” once the selected time’s measurement has been finished.

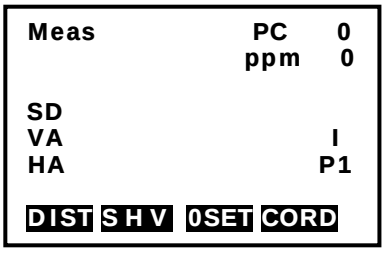
6. Coordinate Measurement

It is possible to find the 3D coordinates of a target by coordinate measurement. Please input the occupied coordinate, instrument height, target height, backsight coordinate (or azimuth angle) and azimuth before coordinate measurement.



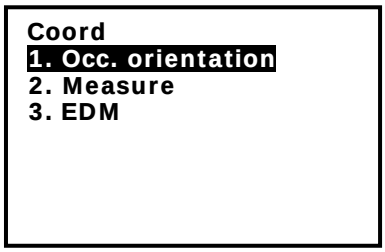
6.1 Input the Occupied Point Data

【Procedure of inputting occupied point data】

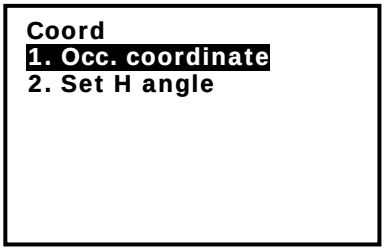


1. Measure the height of target and instrument with a tape, etc.

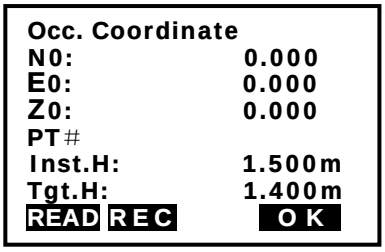
2. Press F4: [**CORD**] at P1 in the measurement mode.



3. Select "**1. Occ. orientation**".



4. Select "**1. Occ. coordinate**" to input the occupied coordinates, instrument height and target height in corresponding items.

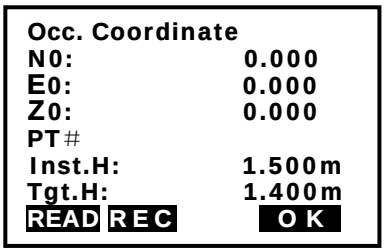


5. Press F4: [**OK**] to set the input data.

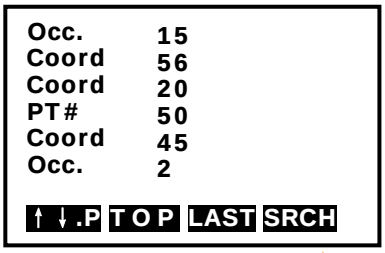
Press F3: [**REC**] to record the data in active occupied data list, see " § 18.1 Record Occupied Data". You could press F1: [**READ**] to read the existed data for occupied point from memory.

How to read the existed data:

Known point data, coordinate data and instrument occupied data in the current JOB and coordinate search JOB can be read. Confirm that the JOB containing the coordinates you wanna read is already selected in coordinate search JOB, see " § 19.1 Select a JOB ".



1. Press F1: [**READ**] when inputting the coordinate.



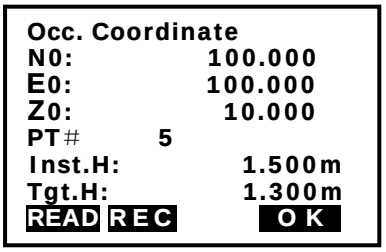
2. The list of existed coordinate displays as shown left:

Occ. : Occupied data saved in the current JOB or in the coordinate search JOB.

Coord: Measured coordiante data saved in the current JOB or in the coordinate search JOB

Pt# : Known point data saved in the current JOB or in the coordinate search JOB.

- [↑ ↓ .P] : Press keys {▲}/ {▼} to move one by one.
- [↑ ↓ .P]: Press keys {◀}/ {▶} to turn the previous/next page.
  Press F1 to switch between [↑ ↓ .P] status and [↑ ↓ .P] status.
- [TOP]: Press it and the first point on the first page will display.
- [LAST]: Press it and the last point on the last page will display.
- [SRCH]: Press it to enter into "coordinate data search" mode. Input the required point number to search.



3. Select the required data and press the key {ENT}. The corresponding data will display. You could re-edit the data and it won't affect the original coordinate data.

4. Press F4: [**OK**] to save the setting.

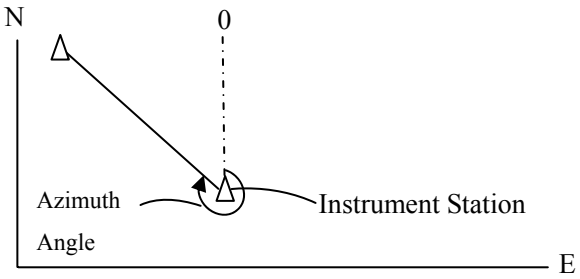
NOTE:

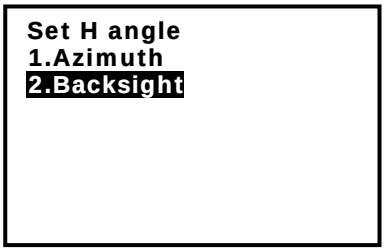
◆ The point number that was read is displayed until the current JOB is changed or a new point number is selected.

◆ If more than two points with the same point name exist in the current JOB, the instrument finds the first recorded data only.

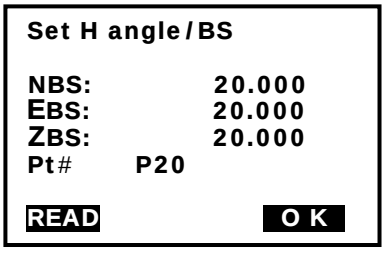
6.2 Azimuth Setting

The azimuth of backsight could be inverse calculated by the coordinates of occupied and backsight.

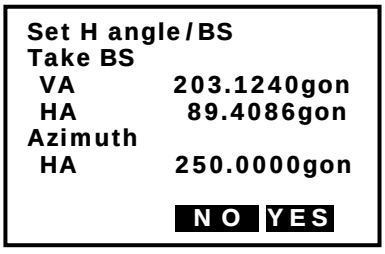




1. Select "**2. Set H angle**", see "§ 6.1 Input the occupied point data". Then select "**2. Backsight**".



2. Input the coordinate of backsight. You could also press F1: [**READ**] to select existed point data. If you input the same coordinates with the occupied point, a message "Same coordinates" will appear and disappear in 5sec，please re-input the data.



3. Press F4: [**OK**] to accept the inputted occupied and backsight coordinates, the calculated azimuth angle will display.

4. Aim at the backsight point, and then press F4: [**YES**] to finish backsight point setting, or press F3: [**NO**] back to the previos mode.

Note:

◆ You can select "**1. Azimuth**" to input the azimuth angle directly.

6.3 3D Coordinate Measurement

The target coordinate could be measured after the setting of occupied point and backsight azimuth.

The formular used to calculate:

N1＝N0＋S×sinZ×cosAz

E1＝E0＋S×sinZ×sinAz

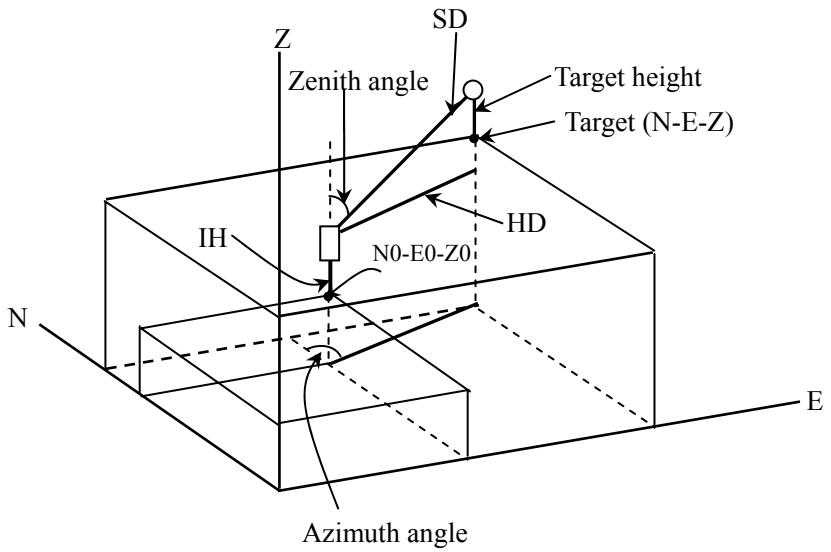
Z1＝Z0＋S×cosZ＋IH－TH

Where：

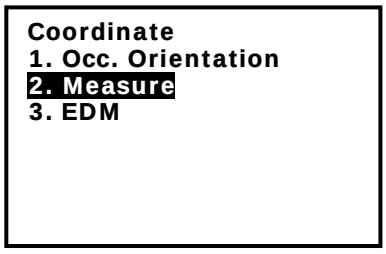
N0-E0-Z0: occupied point coordinates

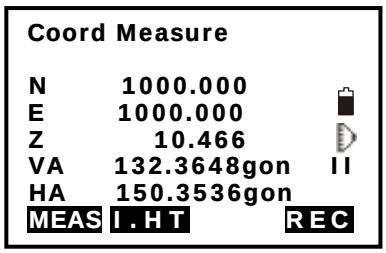
S：SD　　Z：Zenith angle　　Az：Azimuth angle

IH：Instrument height　　TH：Target height



【Procedure of 3D coordinates measurement】





1. Aim at the target point.
2. Select "**2. Measure**" to start. The coordinate value of the target is displayed.
3. Press F2: [**I.HT**] to re-input the occupied data if necessary, see " § 6.1 Input the occupied point data". You can press F4: [**REC**] to record the data.
4. Aim at the next target, press F2: [**I.HT**] to re-input the target height if necessary, and press F1: [**MEAS**] to continue. Follow this operation till all targets have been measured.
5. Press key {ESC} back to the coordinate mode.

7. Stake out Measurement

Stake out measurement is used to stake out the required point. The difference between the previously inputted data to the instrument（the stake out data）and the measured value can be displayed by measuring the horizontal angle, distance or coordinates of the sighted point.

The horizontal angle difference and distance difference are calculated and diplayed using the following formulars:

Horizontal angle difference

dHA=Horizontal angle of stake out data – measured horizontal angle

Distance difference

Distance Displayed item

SD: S-O SD=measured slope distance – slope distance of stake out data

HD: S-O HD=measured horizontal distance – horizontal distance of stake out data

VD: S-O VD=measured height difference – height difference of stake out data

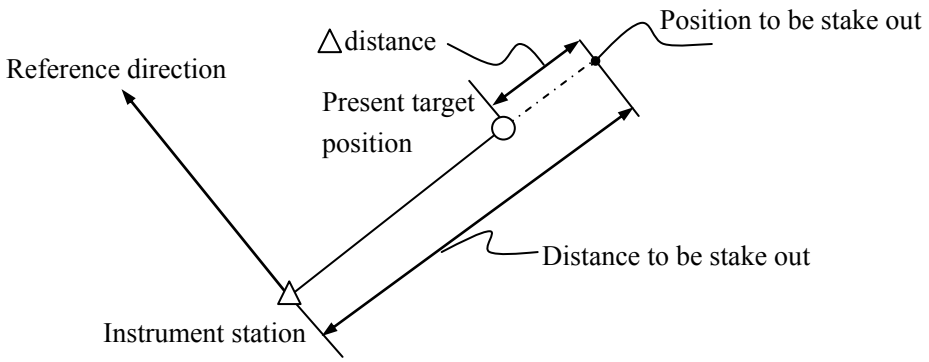
NOTE:

◆ Stake out data can be input in various modes: SD, HD, VD, coordinates and REM measurement.

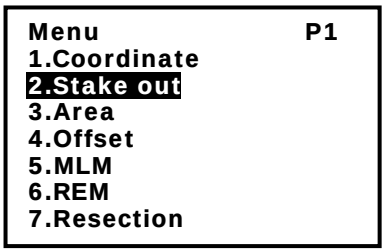
◆ EDM settings could be set in this mode.

7. 1 Distance Stake out

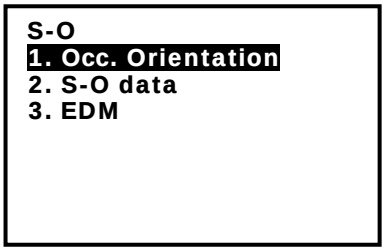
The point to be found based on the horizontal angle from the reference direction and the distance from the instrument station.



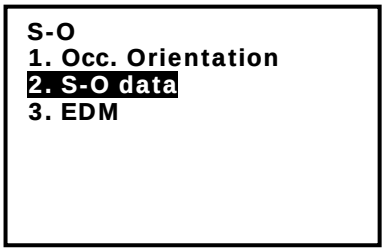
【Procedure of distance stake out measurement】



1. Press F1: [**MENU**] at P2 in the measure mode.
Select "**2. Stake out**".

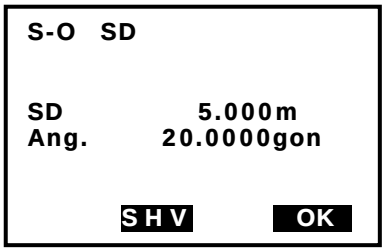


2. Select "**1. Occ. Orientation**".
Input the occupied orientation data, see " § 6.1 Input the occupied point data ".
Then set the azimuth angle of the backsight point, see " § 6.2 Azimuth setting".

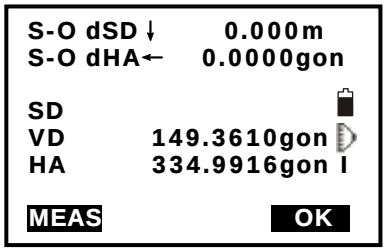


3. Select "**2. S-O data**".

4. Select "**2. Angle & Dist**".



. Press F2: [**SHV**] to shift between S-O SD, S-O HD, S-O VD.
Input the following items:
SD/HD/VD: distance from the instrument station to the position to be stake out;
Ang.: included angle between the direction of the reference and the point to be stake out. See " § 4.2 Set the Horizontal Angle to a Required value".
Press F4: [**OK**] to set the input values.



6. Horizontally rotate the instrument until "dHA" is 0 and set the target on the sight line.
Press F1: [**MEAS**] to start distance measurement.

```
S-O
1. Occ. Orientation
2. S-O data
3. EDM
```

7. The difference of measured value and stake out value "**S-O dSD**" is displayed.

Move the prism forward and backward until "S-O dSD" is 0m.

←: Move the prism to left

→: Move the prism to right

↓ : Move the prism forward

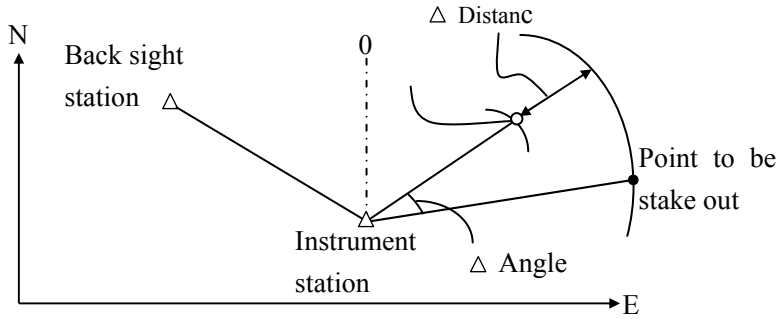
↑ : Move the prism backward

Press F4: [**OK**] back to stake out mode.

7.2 Coordinates Stake out Measurement

After setting coordinates for the point to be stake out, the instrument calculates the stake out HA and HD. By selecting the HA and then the HD stake out functions, the required coordinate location can be stake out.

To get the Z coordinate, attach the target to a pole etc, with the same target height.



【Procedure of coordinate stake out measurement】

```
Menu                P1
1.Coordinate
2.Stake out
3.Area
4.Offset
5.MLM
6.REM
7.Resection
```

1. Press F1: [**MENU**] at P2 in the measure mode.

Select "**2. Stake out**".

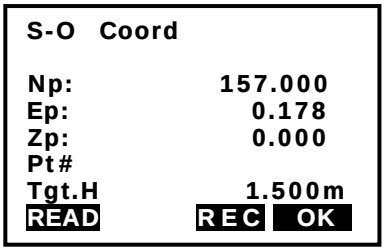
2. Select "**1. Occ. Orientation**".

Input the occupied orientation data, see " § 6.1 Input the occupied point data ".

Then set the azimuth angle of the backsight point, see " § 6.2 Azimuth setting".

```
Stake out
1.Height
2.Angle & Dist
3.Coord
```

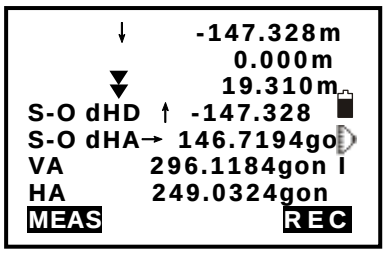
3. Select "**2. S-O data**", then select "**3.Coord**".



4. Input the coordinates of the stake out point.

Press F1: [**READ**] to read the existed coordinates as stake out coordinate.

Press F4: [**OK**] to set the data.



5. Press F1: [**MEAS**] begin coordinate stake out measurement. Move the prism to find the point to be stake out.

▲▲ : Move the prism upward

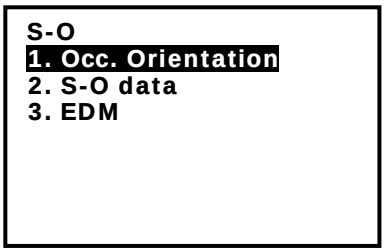
▼▼ : Move the prism downward

Press key {ESC} back to stake out mode.

7.3 REM Stake out Measurement

Perform this operation to find a point where a target cannot be directly installed, see " § 11 REM".

【Procedure of REM stake out measurement】



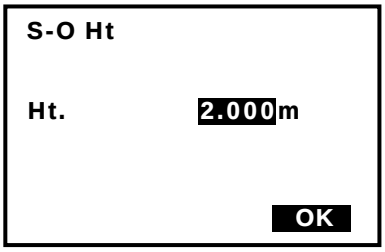
1. Set a target directly below or directly above the point to be found, then use a measuring tape etc. to measure the target height (height from the surveying point to the target).

Press F1: [**MENU**] at P2 in the measure mode, then select "**2. Stake out**".

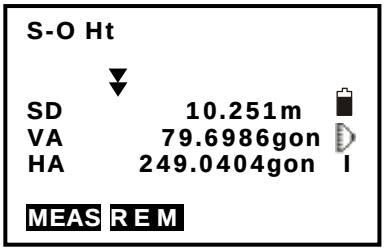
2. Select "**1. Occ. Orientation**".

Input the occupied orientation data, see " § 6.1 Input the occupied point data ".

3. Select "**2. S-O data**", then select "**1. Height**".



4. Input height from the surveying point to the position to be stake out. Then press F4: [**OK**] to set the data.



5. Press F1: [**REM**] to begin REM stake out measurement. Move telescope to find the point to be stake out.

▼▼ : Move the telescope near the zenith

▲▲ : Move the telescope near the nadir

Press key {ESC} back to stake out mode.

8. Area

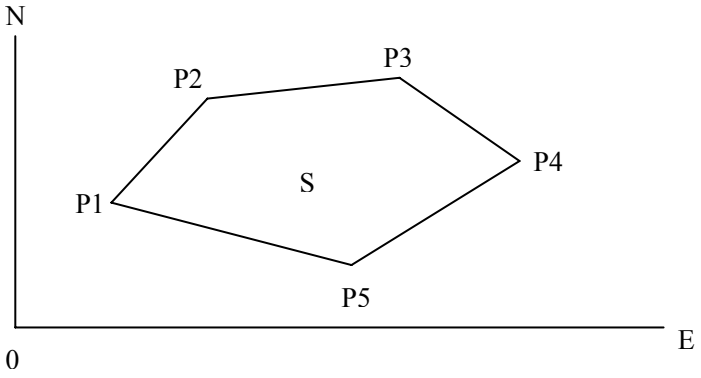
Calculate an area shaped with several points. The coordinate data of the points could be either measured or input by hand.

Input:

Coordinates: P1 (N1, E1)
P2 (N2, E2)
P3 (N3, E3)
…

Output:

Area：S

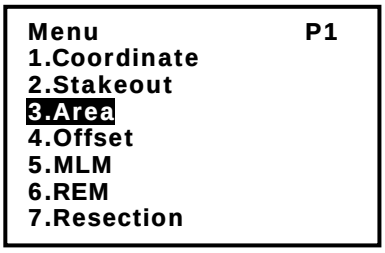


NOTE:

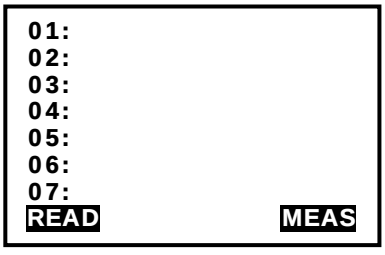
- The number of points: 3 ~ 30.
- Make sure these points must be measured or listed clockwise or anticlockwise, or mistake will result.

8.1 Area Calculation by Measured Data

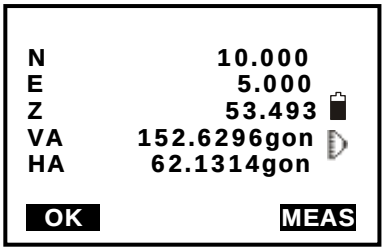
【Procedure of area calculation】



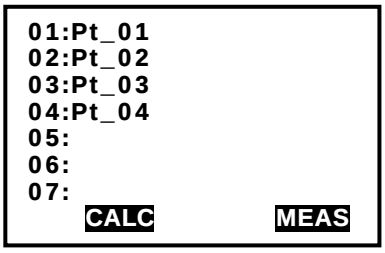
1. Press F1: [**MENU**] at P2 in the measure mode.
   Select "**3. Area**".



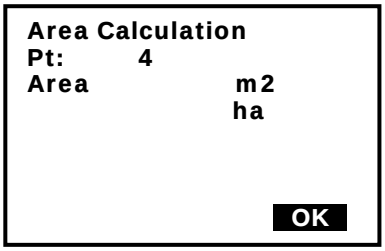
2. Aim at the first point, and then press F4: [**MEAS**].



3. Press F4: [**MEAS**] to re-measure distance. Press F1: [**OK**], the measured data is set as"Pt-01".



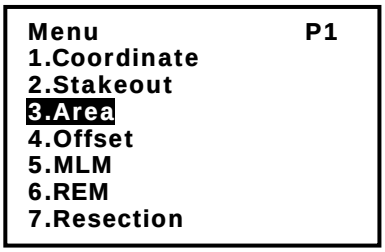
4. Repeat steps 2 and 3 till all points are measured one by one. Make sure measure them clockwise or anticlockwise. Press F2: [**CALC**] and the calculated area will display.



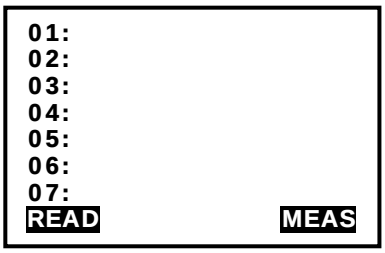
5. Press F4: [**OK**] back to menu mode.

8.2 Area Calculation by Reading Existed Coordinates

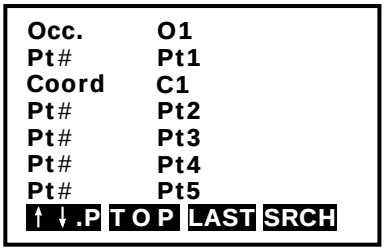
【Procedure of area calculation】



1. Press F1: [**MENU**] at P2 in the measure mode.
   Select "**3. Area**".

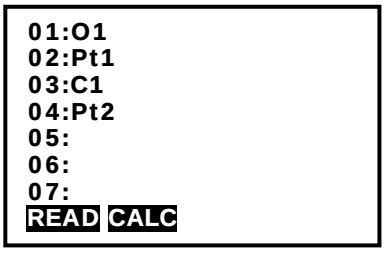


2. Press F1: [**READ**] to display existed coordinates data list.



3. Pt#: Known point data saved in the active JOB or in the coordinate search JOB.

Occ./Coord: Coordinte data saved in the active JOB or in the coordinate search JOB.

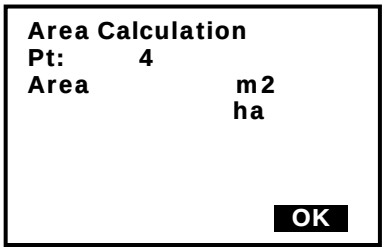


4. Select the first point in the list and press key {ENT} to set.

The selected point is set as "Pt-01".

5. Repeat steps 2 and 4 till all points are selected.

Make sure read the points clockwise or anticlockwise.



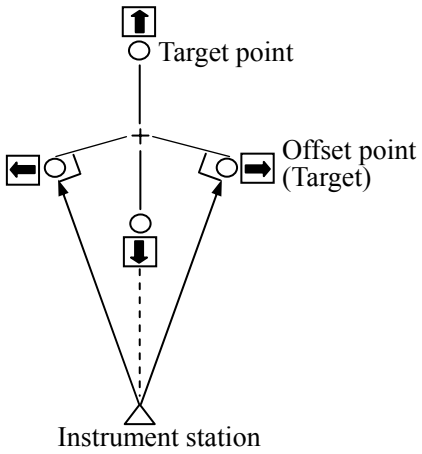
6. Press F2: [**CALC**], and the calculated area will display. Press F4: [**OK**] to escape.

9. Offset Measurement

Offset measurement are performed in order to find a point where a target cannot be installed directly or to find the distance and angle to a point which cannot be sighted.
It is possible to find the distance and angle to a point you wish to measure (target point) by installing the target at a location (offset point) a little distance from the target point and measuring the distance and angle from the surveying point to the offset point.
The target point could be found in the following three ways.

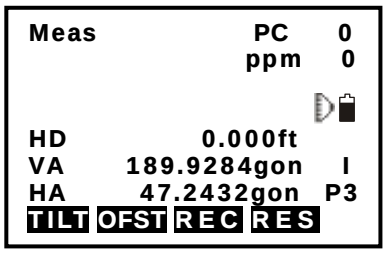
9.1 Single-distance Offset Measurement

Finding a point by entering the horizontal distance from the target point to the offset point.

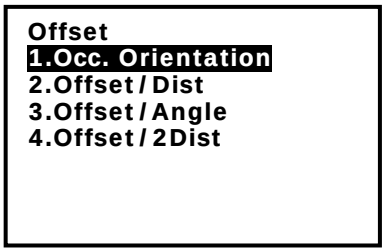


When the offset point is positioned to the left or right of the target point, make sure the angle formed by lines connecting the offset point to the target point and to the instrument station is almost 90°.
When the offset point is positioned in front of or behind the target point, installs the offset point on a line linking the instrument station with the target point.

【Procedure of single-distance offset measurement】

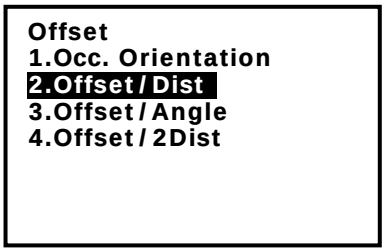


1. Set the offset point close to the target point and measure the distance between them, then set up a prism on the offset point.
2. Aim at the offset point and press F1: [**MEAS**] to measure the distance at P1 in measure mode.
3. Select [**MENU**] at P2 in measure mode, and then

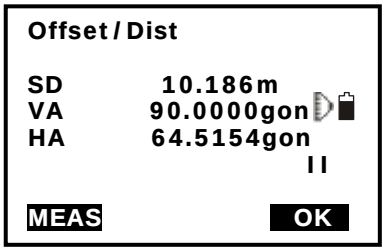


select "**4. Offset**", or press F2: [**OFST**] at P3 directly.

4. Select "**1. Occ. orientation**" to input the instrument occupied data, see " § 6.1 Input the occupied point data".



5. Select "**2. Offset / Dist**".



6. User could press F1: [**MEAS**] to re-measure the offset point or press F4: [**OK**] to the next step.

7. Input distance and direction of offset point:.

① Dist: horizontal distance from the target point to the offset point.

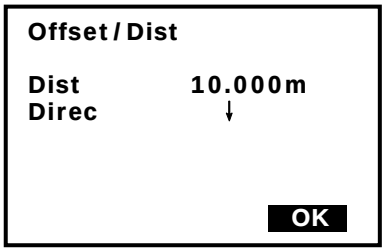
② Direc: diretion of the offset point.

←: on the left of the target point

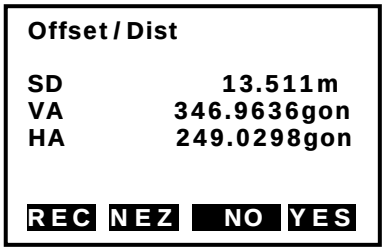
→: on the right of the target point

↓ : in front of the target point

↑ : at back of the target point



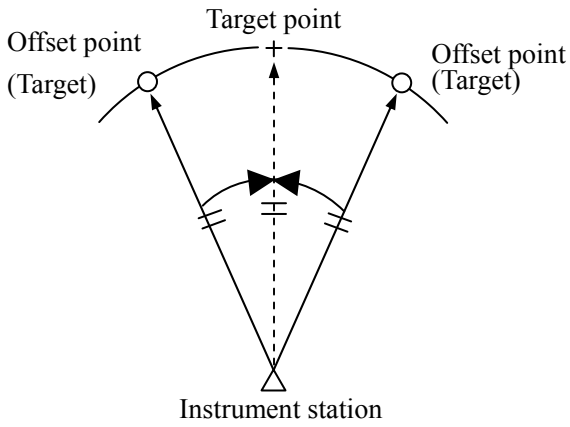
8. Press F4: [**OK**] to calculate and display the distance and angle of the target point.



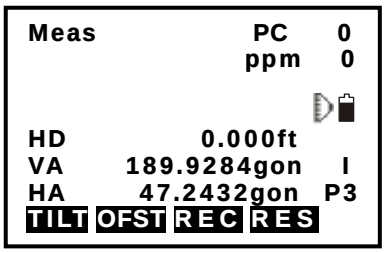
9. Press F1: [**REC**] to save;
Press F2: [**NEZ**] to display NEZ coordinate;
Press F3: [**NO**] back to step 6;
Press F4: [**YES**] back to offset mode.

9.2 Angle Offset Measurement

Sighting the direction of the target point to find it from the included angle. Set offset points for the target point on the right and left sides of and as close as possible to the target point and measure the distance to the offset points and the horizontal angle of the target point.

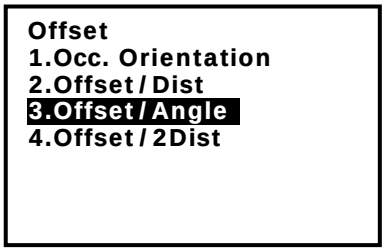


【Procedure of angle offset measurement】



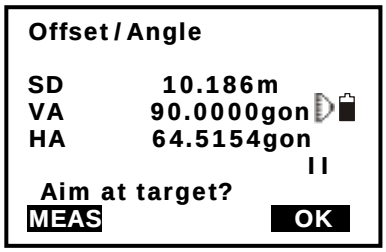
1. Set the offset points close to the target point (making sure the distance from the instrument station to the target point and the height of the offset points and the target point are the same), then use the offset points as the target.

2. Aim at the offset point and press F1: [**MEAS**] to measure the distance at P1 in measure mode.

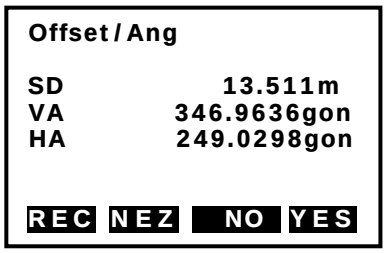


3. Select [**MENU**] at P2 in measure mode, and then select "**4. Offset**", or press F2: [**OFST**] at P3 directly.

4. Select "**3. Offset/Angle**" after inputting instrument occupied data, see " § 6.1 Input the occupied point data".



5. Accurately sight the direction of the target point and press F4: [**OK**], the distance and angle of the target point are displayed.



6. After finishing measurement:

Press F1: [**REC**] to save;

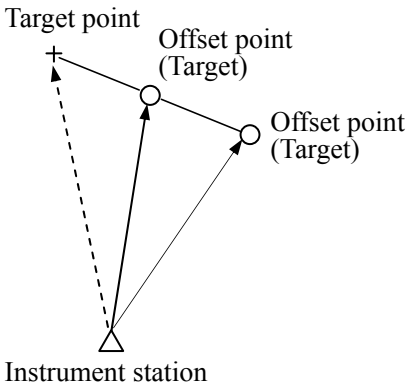
Press F2: [**NEZ**] to display NEZ coordinate;

Press F3: [**NO**] back to step 6;

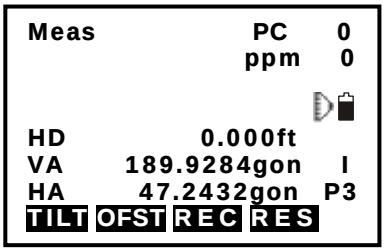
Press F4: [**YES**] back to offset mode.

9.3 Dual-Distance Offset Measurement

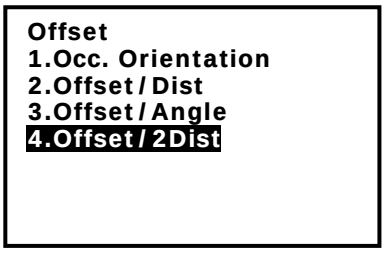
By measuring the distance between the target point and the two offset points. Set two offset points (1st target and 2nd target) on a straight line from the target point, measure the 1st and 2nd target, then input the distance between the 2nd target and the target point to find the target point.



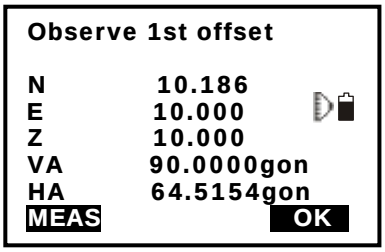
【Procedure of dual-distance offset measurement】



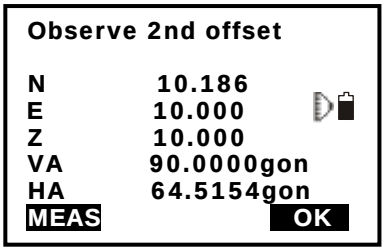
1. Set two offset points (1st target, 2nd target) on a straight line from the target point and use the offset points as target.
2. Select [**MENU**] at P2 in measure mode, and then select "**4. Offset**", or press F2: [**OFST**] at P3 directly.



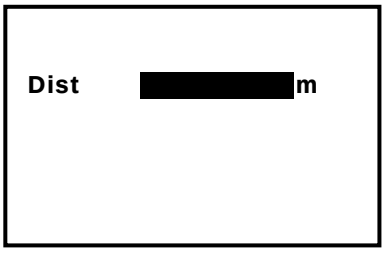
3. Select "**4. Offset/2Dist**" after inputting the instrument occupied data, see " § 6.1 Input the occupied point data".



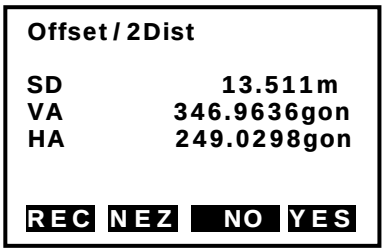
4. Aim at the 1st target and press F1: [**MEAS**] and measured data will display. Press F4: [**OK**] to accept this value.



5. Sight the 2nd target, press F1: [**MEAS**] and measured data will display, press F4: [**OK**] to accept this value.



6. Input the distance from 2nd point to the target point and press key {ENT}, the angle and distance of the target point are displayed.



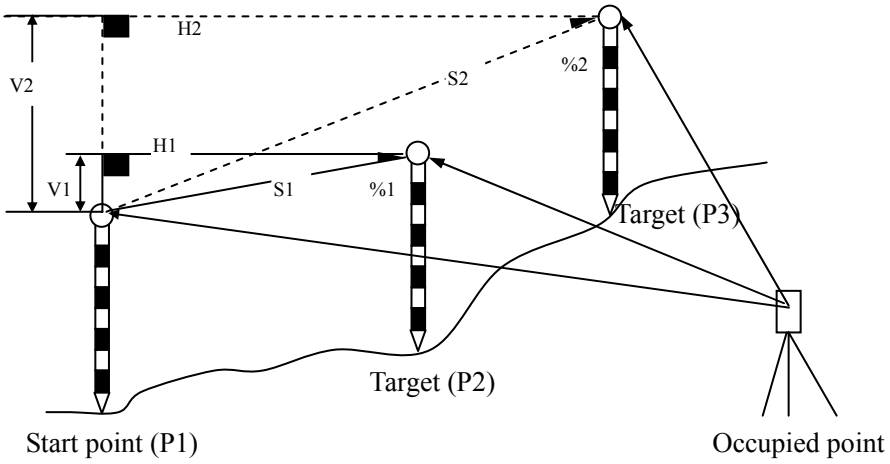
7. Press F1: [**REC**] to save;
   Press F2: [**NEZ**] to display NEZ coordinate;
   Press F3: [**NO**] back to step 6;
   Press F4: [**YES**] back to offset mode.

10. MLM

MLM is used to directly measure slope distance, horizontal distance and the height difference from one base point to other points without moving the instrument.

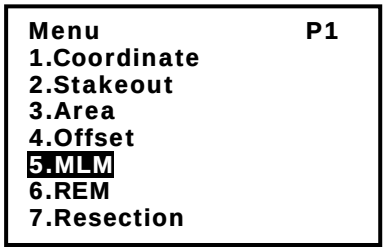
NOTE:

- The last measured data could be set as the base point for the next operation.
- The height difference between one point and the base point could be displayed as grade mode.

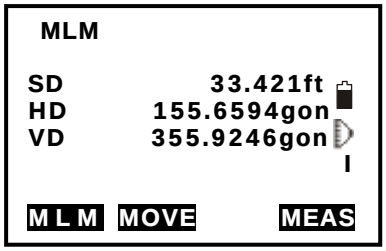


10.1 Measuring Distance between Two or More Points

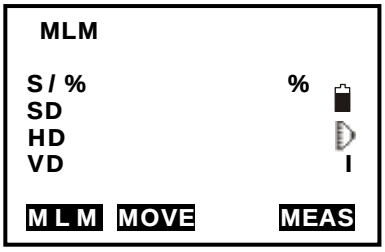
【Procedure of measuring】



1. Press F1: [**MENU**] at P2 in the measure mode.
   Select "**5. MLM**".



2. Aim at the start point P1, then press F4: [**MEAS**] and the measured data will display.
3. Aim at the target point P2 and press F1: [**MLM**] to begin measure, SD, HD, VD will display.



4. Aim at the next point P3 and press F1: [**MLM**] to begin measure. Repeat this operation to measure other target points.

5. Press F2: [**MOVE**], the last target measured becomes the new starting position to perform MLM of next target.

Press F4: [**MEAS**] to re-measure the starting position.

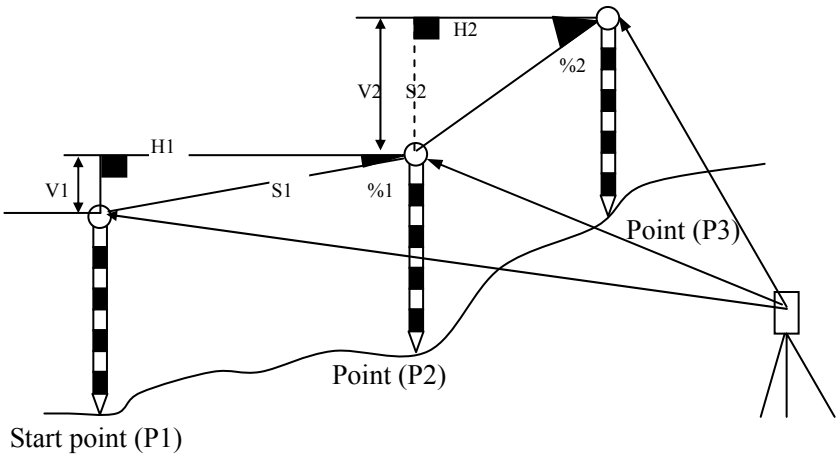
6. Press key {ESC} back to menu mode.

Note:

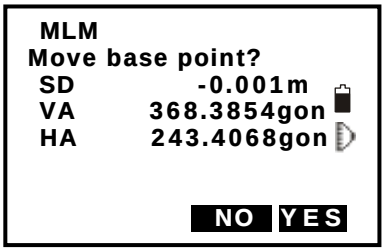
◆ Once "S/%" is displayed, the distance between two points is displayed as the gradient

10.2 Change the Starting Point

The previous measured data could be set as the base point for the next operation.



【Procedure of changing the starting point】

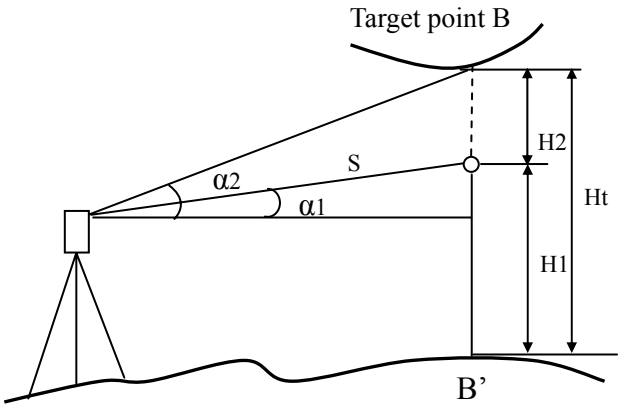


1. Measure the start point P1 and the first target P2 following above steps 1, 2 and 3.

2. After measuring the two points, press F2: [**MOVE**], and press F4: [**YES**] to set the last measured point as new starting point, or press F3: [**NO**] to give up.

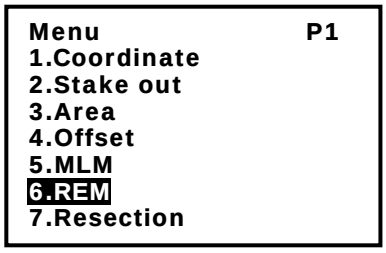
11. REM

REM is a function used to measure the coordinate and height to a point where a target cannot be directly installed such as power lines, overhead cables or bridges, etc.

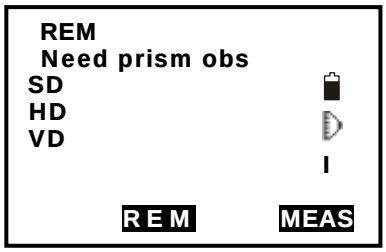


Here is the equation used to calculate the data presented in above figure:
Ht=H1+Scosα1tgα2-Ssinα1

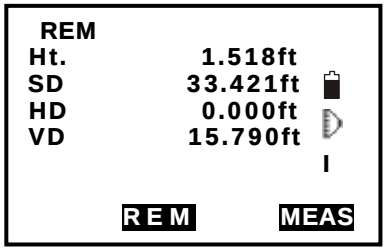
【Procedure of REM】



1. Set a target directly under or directly over the object and measure the target height with a tape measure etc.
2. Select [**MENU**] on P2 in measure mode, then select "**6.REM**" on P1 to enter into REM status.



3. Reference point measurement.
Aim at the prism accurately, and press F4: [**MEAS**] to measure distance. Press F4: [**STOP**] and the measured data are displayed. Press F4: [**MEAS**] to re-measure.



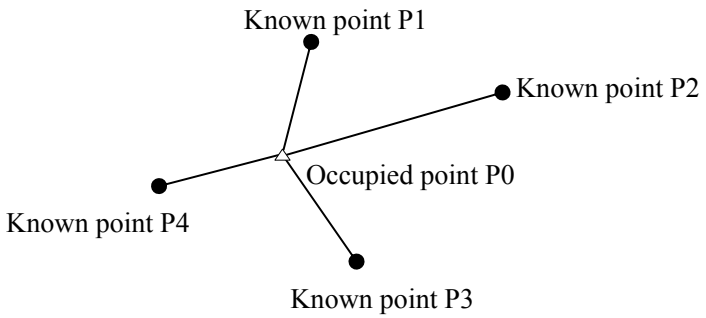
4. Aim at the target accurately and press F2: [**REM**]. The height from ground to the target is displayed in "**Ht**". Press F4: [**MEAS**] to repeat and press key {ESC} back to menu mode.

12. Resection

Resection program is used to determine the coordinates of an instrument station (unknown) by measuring several known points. Coordinate data in memory could be read.

Input
Coordinates of known points: Xi, Yi, Zi
Measured HA: Hi
Measured VA: Vi
Measured distance: Di

Output
Coordinate of occupied data: Xo, Yo, Zo

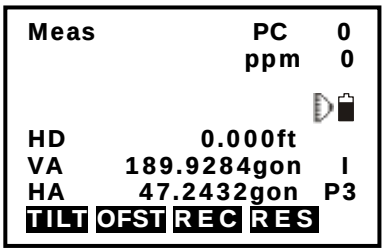


NOTE:
◆ All N, E, Z value or only Z value of the occupied point is calculated by measuring known points.
◆Coordinate resection measurement overwrite the N, E, Z data of the instrument occupied point, while elevation resection measurement overwrite Z data only. Perform resection measurement, see "§ 12.1 Coordinate Resection" and "§ 12.2 Elevation Resection".
◆Inputted known coordinate data and calculated data could be recorded in the current JOB.

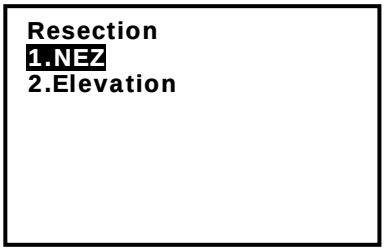
12.1 Coordinate Resection

Between 2 and 5 known points can be measured by distance measurement and angle measurement.

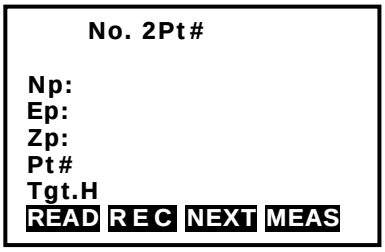
【Procedure of coordinate resection】



1. Select [**MENU**] at P2 in measure mode, and then select "**7. Resection**", or select [**RES**] at P3 directly.

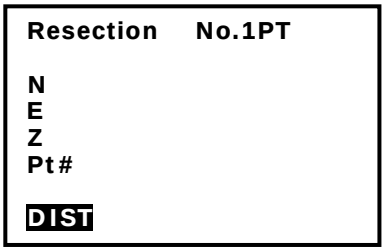


2. Select "**1.NEZ**" and input known point data. After inputting the data of the first known point, press F3: [**NEXT**] to input the second point data.

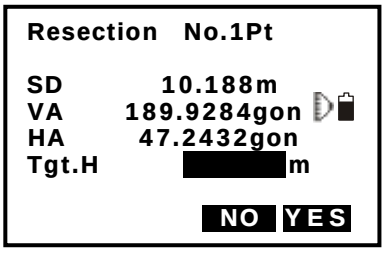


3. After all known points data have been set, press F4: [**MEAS**].

Press F1: [**READ**] to read existed coordinate data.



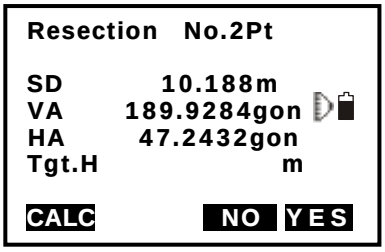
4. Sight the first known point and press F1: [**DIST**] to begin measurement.

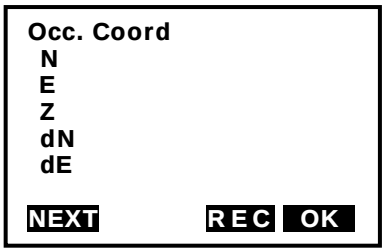


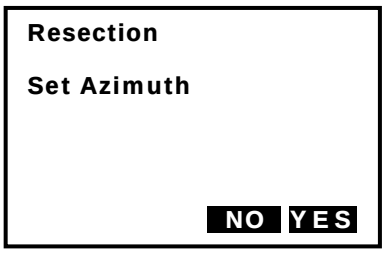
5. Press F4: [**YES**] to use the measured data of the first known point.

Press F3: [**NO**] to re-measure this point.

You can also input target height here.







6. Repeat procedures 4 and 5 of other points.
When the minimum quantity of measured data required for the calculation is present, [**CALC**] will be displayed.

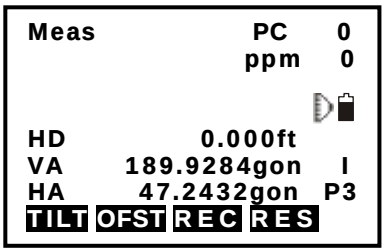
Press F1: [**CALC**] to calculate. Instrument occupied coordinate and standard deviation are displayed.
Press F3: [**NO**] to re-measure the point.

7. Press F1: [**NEXT**] to add other known points.
Press F3: [**REC**] to record the calculated result.
Press F4: [**OK**] to finish coordinate resection.
The instrument occupied coordinate setting is finished.
8. In this <Set Azimuth> screen, aim the first point then press F4: [**YES**] to set the first known point as backsight point and azimuth, press F3: [**NO**] to back to measure mode.

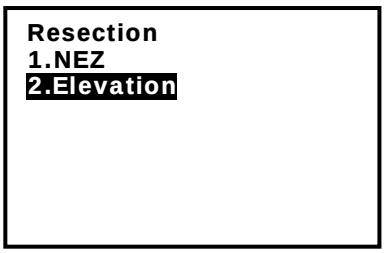
12.2 Elevation Resection

Only Z (elevation) of an instrument station is dertermined by this measurement. Between 1 and 5 known points can be measured by distance measurement only.

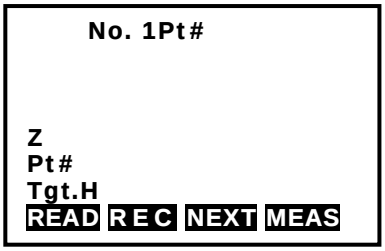
【Procedure of elevation resection】



1. Select [**MENU**] at P2 in measure mode, and then select "**7. Resection**", or press F4: [**RES**] at P3 directly.



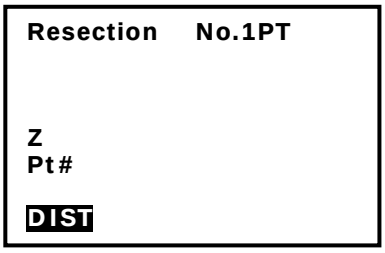
2. Select "**2. Elevation**" and input the known point.



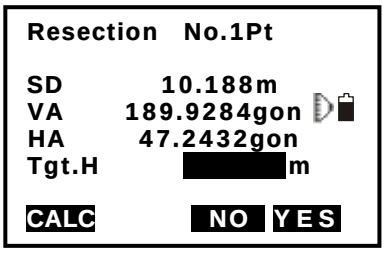
3. After setting the elevation for the first known point, press F3: [**NEXT**] to set the second point data.

4. After all known points data have been set, press F4: [**MEAS**].

Press F1: [**READ**] to read existed coordinate data.



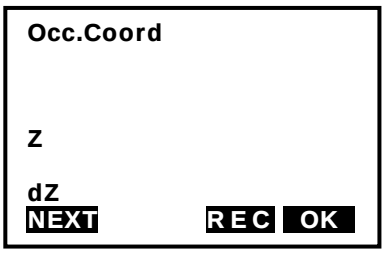
5. Sight the first known point and press F1: [**DIST**] to begin measurement. The measured data are displayed.



6. Press F4: [**YES**] to use the measured data of the first known point data.

Press F3: [**NO**] to re-measure the point. You can also input target height here.

After finishing two measurements, [**CALC**] will be displayed.



6. Press F1: [**CALC**] to calculate. Instrument occupied elevation and standard deviation are displayed.

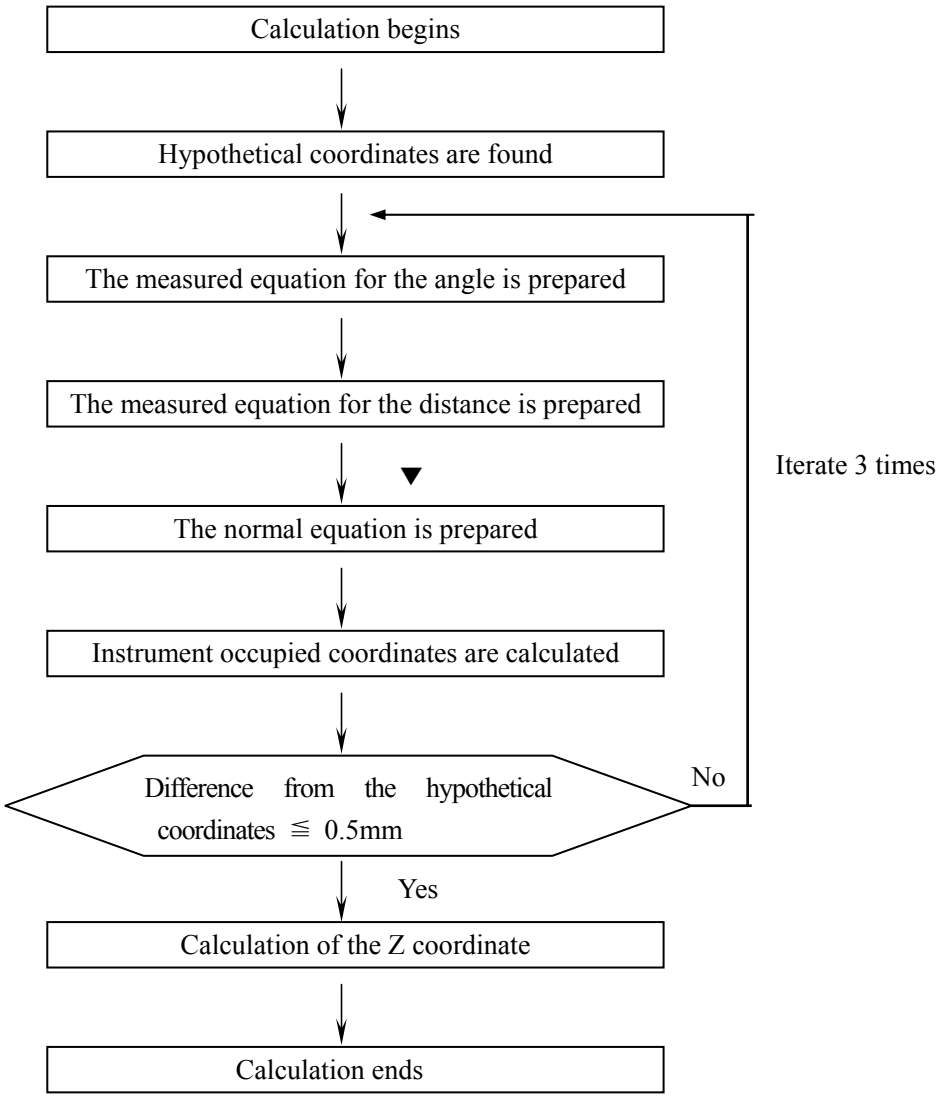
7. Press F1: [**NEXT**] to add other known points.

Press F3: [**REC**] to record the calculated result.

Press F4: [**OK**] to finish elevation resection. Only Z (elevation) of the instrument occupied coordinate is set. N and E values would not be overwritten.

12.3 Resection Calculation Process

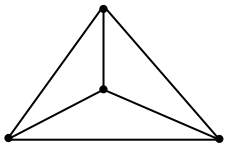
The N, E coordinates are found by angle and distance measurement equations, and the instrument occupied coordinates are found using the least squares method. The Z coordinate is found by treating the average value as the instrument occupied coordinate.


Calculation begins
Hypothetical coordinates are found
The measured equation for the angle is prepared
The measured equation for the distance is prepared
The normal equation is prepared
Instrument occupied coordinates are calculated
Difference from the hypothetical coordinates ≦ 0.5mm
No
Iterate 3 times
Yes
Calculation of the Z coordinate
Calculation ends

12.4 Precautions When Performing Resection

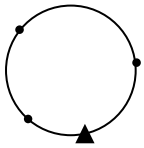
In some cases it is impossible to calculate the coordinates of occupied point if the unknown point and three or more known points are arranged on the edge of a single circle. It is also impossible to calculate if the included angle between the known points is too small. It is difficult to imagine that the longer the distance between the instrument occupied and known points, the narrower the included angle between the known points. Be careful for the points can easily be aligned on the edge of a single circle.

An arrangement such as shown below is desirable.



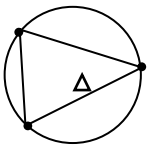
△▲: unknown point
○●: known point

It is sometimes impossible to perform a correct calculation such as shown below.

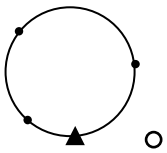


When they are on the edge of a single circle, take one of the following methods:

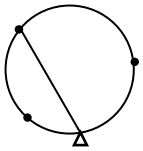
(1) Move the instruction station as close as possible to the center of the triangle.



(2) Measure one more known point which is not on the circle.

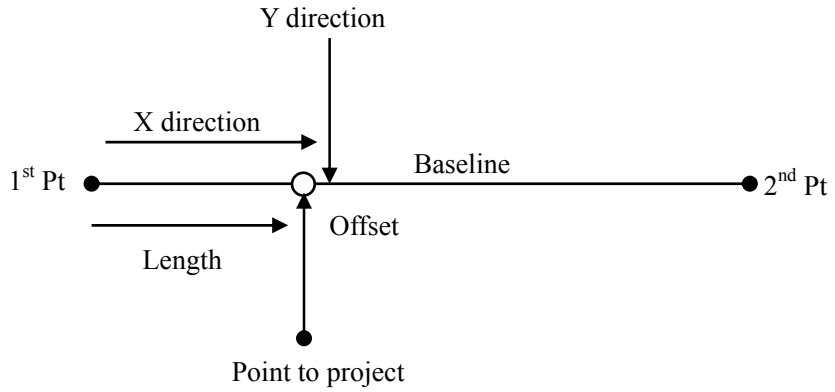


(3) Perform a distance measurement on at least one of the three points.



13. Point Projection

Point projection is used for projecting a point to an established baseline. The point to project can be either measured or input. Displays the distances from the first point and point to project to the position at which a line extending from point to project intersects the baseline at right angles.

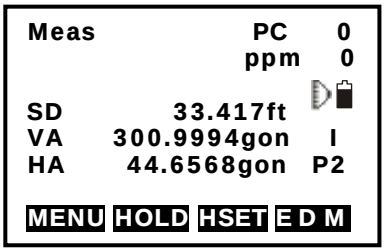


Length: Distance along the baseline from 1st point to 2nd point (X direction).

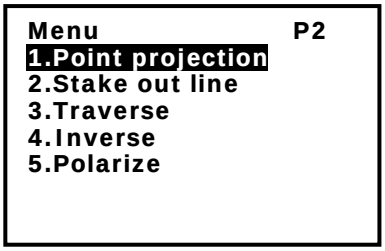
Offset: Distance from point to project to the position at which a line extending from point of project intersects the baseline at right angles (Y direction).

13.1 Define Baseline

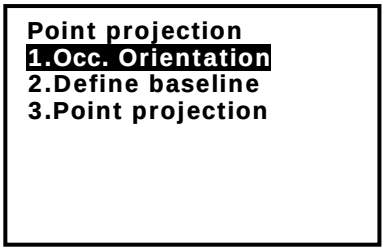
【Procedure of defining baseline】



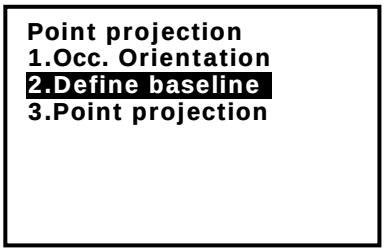
1. Press F1: [**MENU**] at P2 in the measure mode.



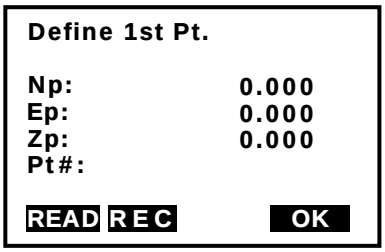
2. Turn to P2, select "**1. Point projection**".



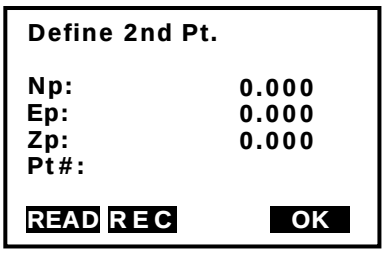
3. Input the instrument occupied data, see "§6.1 Input the occupied point data".



4. Select "**2. Define baseline**".

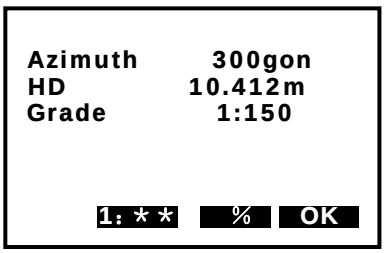


5. Input the first point data, or press F1: [**READ**] to use existed coordinates data.



6. Press F4: [**OK**] to input the second point data.

7. Press F4: [**OK**] to finish defining baseline. The grade of the baseline will display.



8. Press F2: [**1:****] or F3: [**%**] to change the grade display mode.

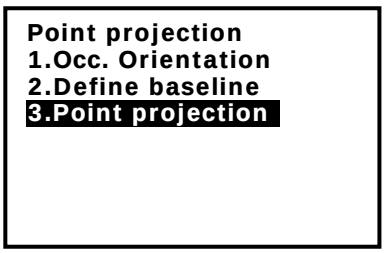
NOTE:

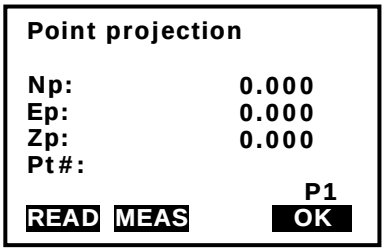
◆ Defined baseline could be used in both stake out line measurement and point projection.

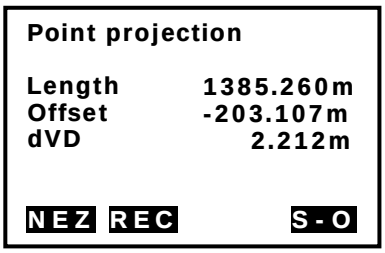
13.2 Point Projection

The baseline must be defined before performing point projection.

【Procedure of point projection】







1. Select "**3. Point projection**" after finishing defining baseline.
2. Input the point coordinate.

   Press F2: [**MEAS**] to measure the point to project.

   When recording the data as a known point, press key {Func}, and press F2: [**REC**] on P2. Record method, see " § 20.1Input Known Point Coordinate by Keys".
3. Press F4: [**OK**] to calculate Length, Offset and dVD will display.

   Length: Distance along the baseline from 1st point to 2nd point (X direction).

   Offset: Distance from point to project to the position at which a line extending from point of project instersects the baseline at right angles (Y direction)

   dVD: Elevation between the baseline and the projected point.

Press F1: [**NEZ**] to display switching between coordinate and distance data.

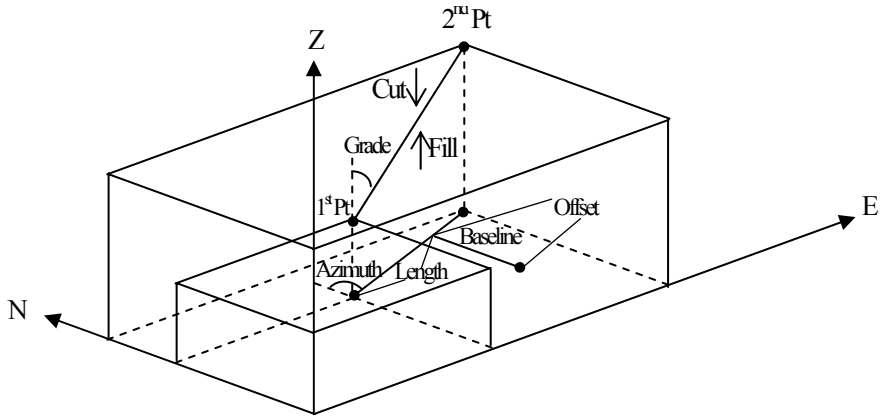
Press F2: [**REC**] to record the coordinate as a known data.

Press F4: [**S-O**] to switch to stake out measurement of the projected point. See "6 Stake out measurement".

Press key {ESC} to continue point projection of a new point.

14. Stake out Line

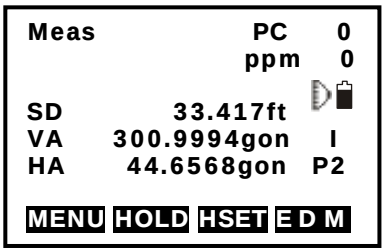
Stake out line is used for stake out a required point at a designed distance from the base line and for finding the distance from the baseline to a measured point.



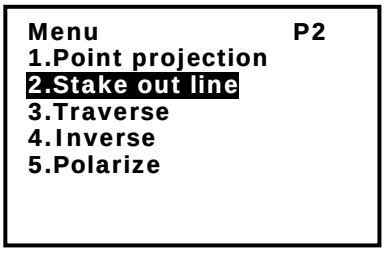
14. 1 Define Baseline

【Procedure of defing baseline】

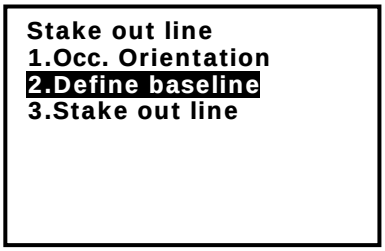
To perform stake out line, please define a baseline first. The baseline can be defined by inputting coordinates of the two points.



1. Press F1: [**MENU**] at P2 in the measure mode.



2. Turn to P2, select "**2. Stake out line**".

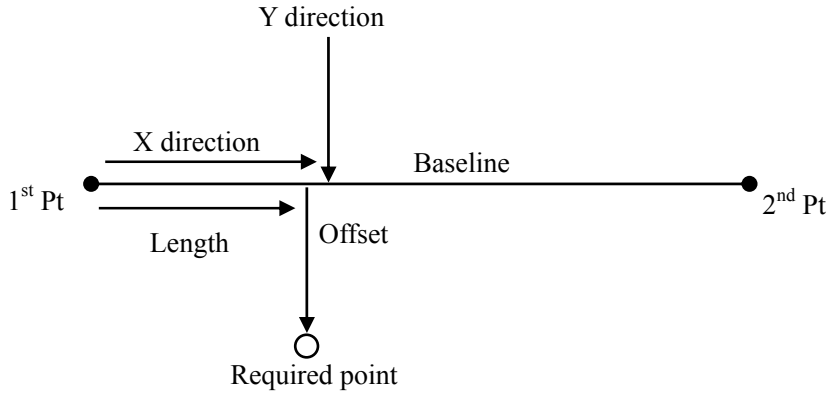


3. Input the instrument occupied data, see "§6.1 Input the occupied point data".

4. Select "**2. Define baseline**", follwing operations see " § 13.1 Define baseline" procedures 5, 6 and 7.

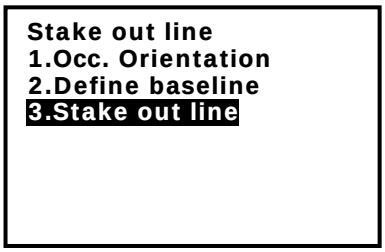
14. 2 Stake Out Line-Point

This measurement can be used to find the required point coordinates by inputting the length and offset based on baseline.

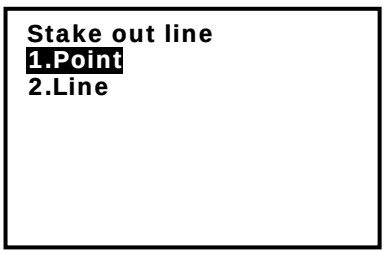


Length: Distance along the baseline from 1st point to the position at which a line extending from the required point intersects the baseline at right angles (X direction)
Offset: Distance from the required point to the position at which a line extending from the required point intersects the baseline at right angles (Y direction).

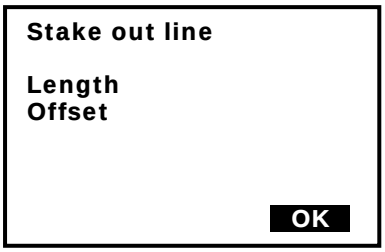
【Procedure of stake out】



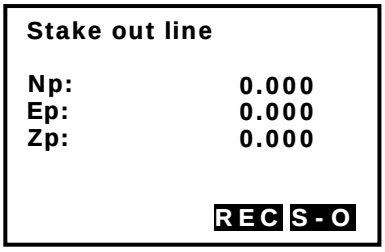
1. Select "**3. Stake out line**" after defining a baseline.



2. Select "**1. Point**"



3. Input values of length and offset, then press F4: [**OK**], the coordinate of the required point is calculated and displayed.



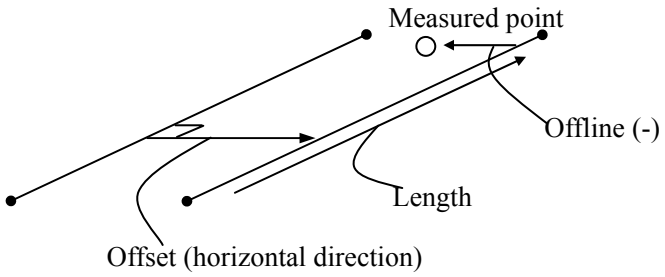
4. Press F3: [**REC**] to record the value as a known point, see " § 20.1 Input Known Point Coordinate by Keys".

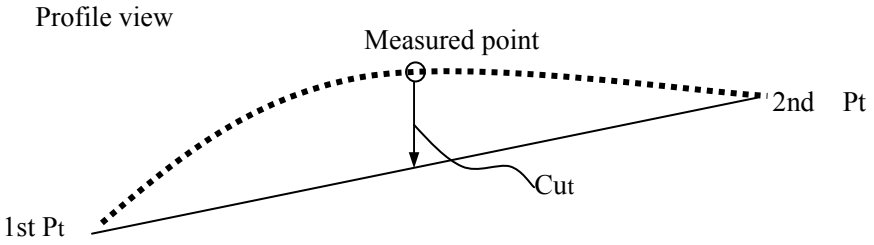
Press F4: [**S-O**] to stake out the required point, see " § 7. Stake out Measurement".

Press key {ESC} to continue.

14.3 Stake out Line/Line

Stake out line-line tells how far horizontally the measured point is from the baseline and how far vertically the measured point is from the connected line. Make sure to define a baseline before this operation.





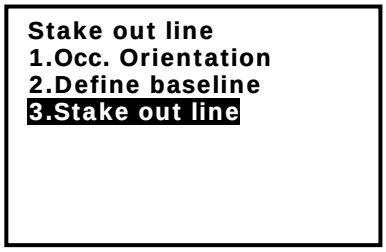
Offline: A positive value indicates the point is on the right of the baseline and a negative value indicates it is on the left.

Cut: indicates that the point is below the baseline.

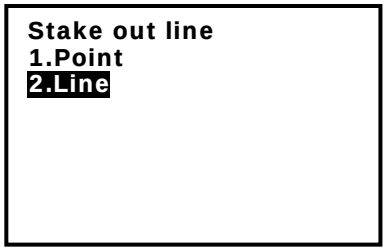
Fill: indicates that the point is above the baseline.

Length: distance along the baseline from 1st point to the measured point.

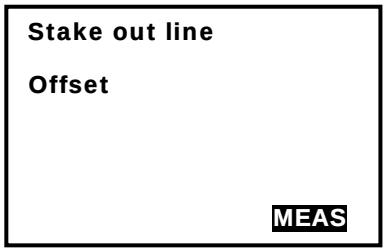
【Procedure of stake out line/line】



1. Select "**3. Stake out line**" after defining a baseline.

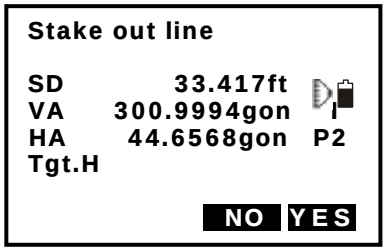


2. Select "**2.Line**".



3. Input offset value: the horizontal move distance of baseline, right side indicates positive value and left side indicates negative value. Go to step 4 without inputting.

4. Aim at the target and press F4: [**MEAS**] to measure. The measured results are displayed.



5. Press F3: [**NO**] to re-measure the target.

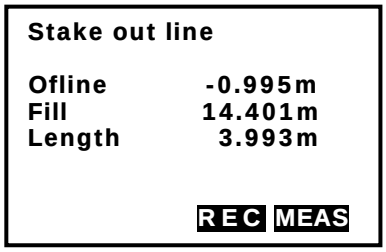
Press F4: [**YES**] to use the measured values. The difference between the measured data and the baseline displays:

Ofline: A positive value indicates the point is on the right of the baseline and a negative value indicates it is on the left.

"Cut" indicates that the point is below the baseline.

"Fill" indicates that the point is above the baseline.

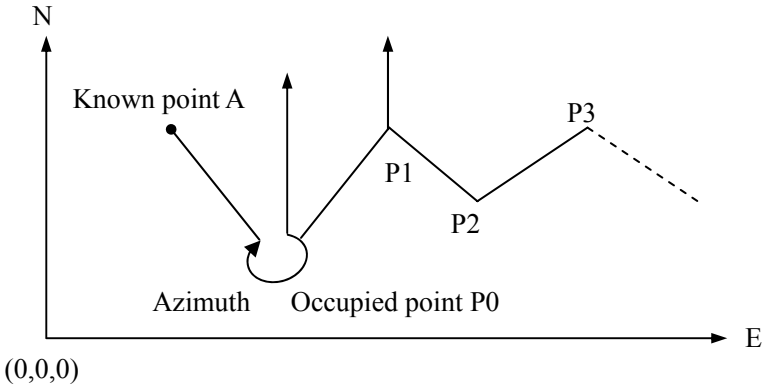
Length: Distance along the baseline from the first point to the measured point.



6. Aim at the next target and press F4: [**MEAS**] to continue the measurement.

15. Traverse Surveying

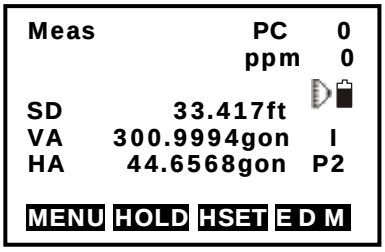
Measure the coordinate of foresight point and save it in the list, this point would be taken as the occupied point after transferring to point 2, and the previous occupied point will be taken as the backsight point, the azimuth angle will be calculated and set.



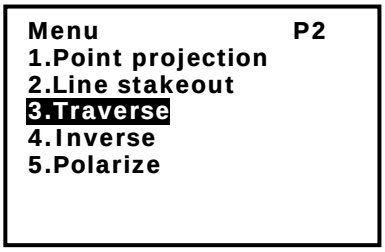
15.1 Save Coordinate

Here is the operation of how to measure the foresight point and save it in the list.

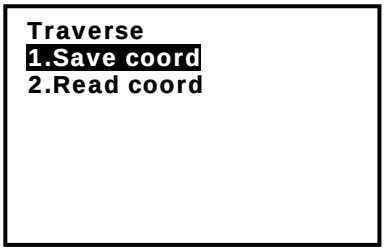
【Procedure of saving coordinate】



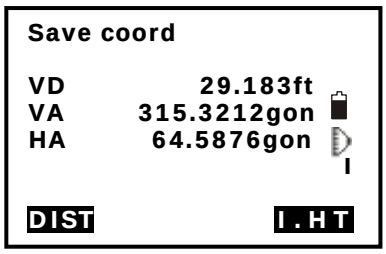
1. Press F1: [**MENU**] at P2 in the measure mode.



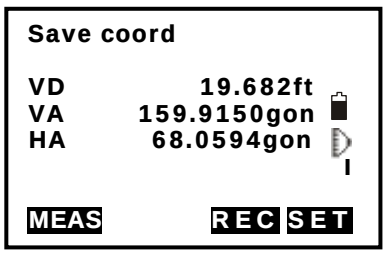
2. Turn to P2, select "**3.Traverse**".



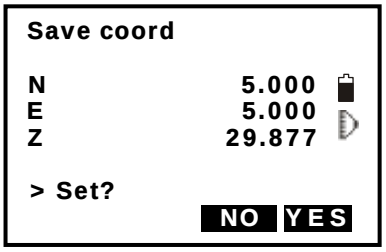
3. Press "**1.Save coord**".



3. Aim at the target point and then press F1: [**DIST**]. You can press F4: [**I.HT**] to re-input instrument height or target height here.



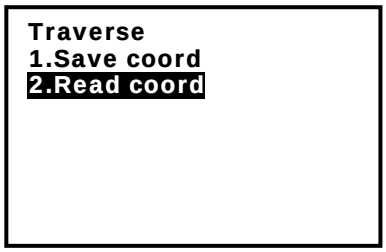
4. Press F4: [**SET**] to save the data, or press F3: [**REC**] to record it in the list.



5. Press F3: [**NO**] back to the previous mode and press F4: [**YES**] to set the data.

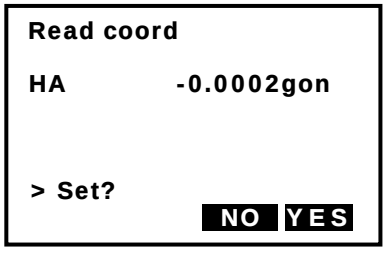
15.2 Read Coordiante

Set the measured foresight point in the saved coordinates list as the occupied point, and the previous occupied point becomes the back point.



1. Move the instrument to the measured forsight point.

2. Select "**2. Read coord**".



3. First aim the previous occupied point, then press F4: [**YES**] to set the previous foresight point coordinate as the occupied point coordinate or press F3: [**NO**] to give up.

16. Inverse

The distance and azimuth from a start point to an end point could be calculated according to input their coordinates.

Input:

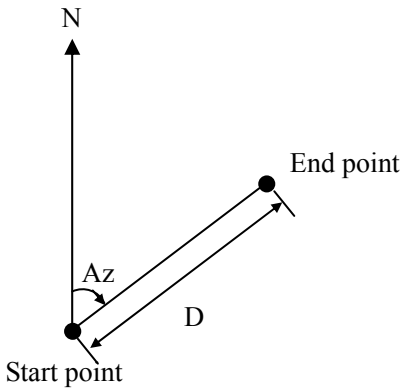
Coordiante of start point: N0,E0,Z0

Coordinate of end point : N1,E1,Z1

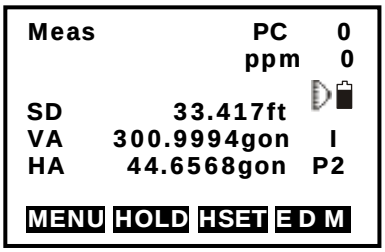
Output:

Distance: D

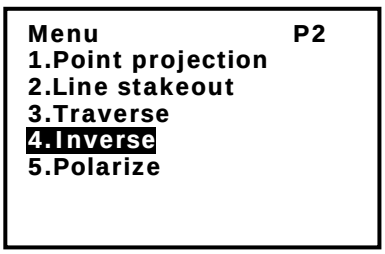
Azimuth: Az



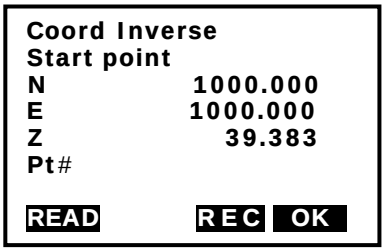
【Procedure of Inversing】



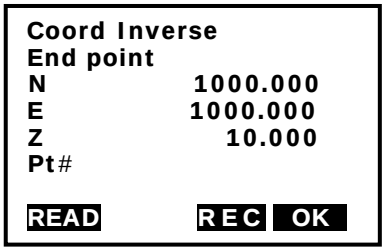
1. Press F1: [**MENU**] at P2 in the measure mode.



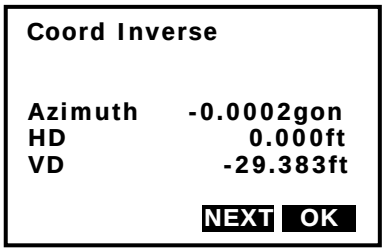
2. Turn to P2, select "**4.Inverse**".



3. Input coordinates of the start point, and press F3: [**REC**] to record the data in the list if necessary. You could press F1: [**READ**] to read the existed data. Press F4: [**OK**] to set.



4. Input coordinates of the end point. See the previous step.



5. The inversed value will display. Press F3: [**NEXT**] to continue, press F4: [**OK**] back to menu mode.

17. Polar Coordinates Calculation

The coordinates of the end point could be calculated according to input azimuth, distance and the NEZ coordinates of start point.

Input:

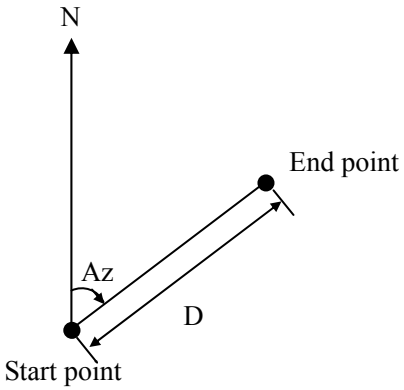
Coordinate of start point: N0,E0,Z0

Azimuth: Az

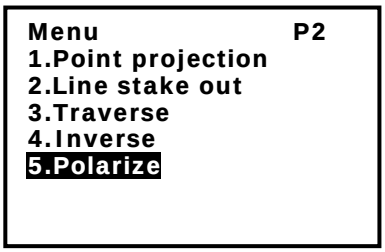
Distance: Dist

Output:

Coordinate of end point:N1,E1,Z1

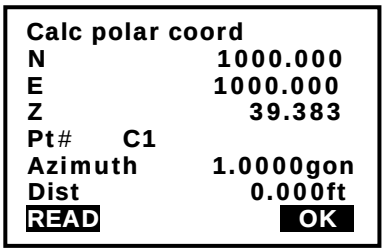


【Procedure of Polarize】

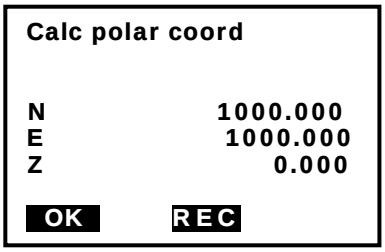


1. Press F1: [**MENU**] on P2 in the measure mode.

2. Turn to P2, select "**5.Polarize**".



3. Input the data in corresponding itmes. You could press F1: [**READ**] to read the existed coordinate data for start point. Press F4: [**OK**] to enter.



4. The calculated data displays. Press F3: [**REC**] to record it in the list, and press F1: [**OK**] back to menu mode.

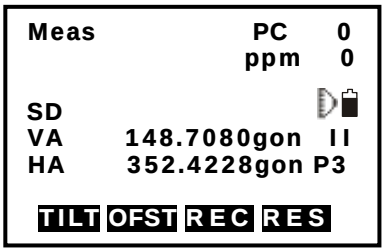
18. Record

You can record measured data, occupied data and notes into the active JOB. The memory is 16000 points in total.

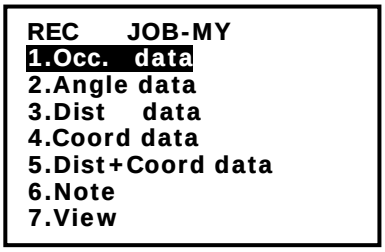
18.1 Record Occupied Data

You can input occupied data into the active JOB. The record items include: occupied coordinates, point number, instrument height, code, user, date, time, weather, wind, temperature, air pressure and ppm. If the current occupied data have not been recorded in the active JOB, the previous occupied data will be used as the active one.

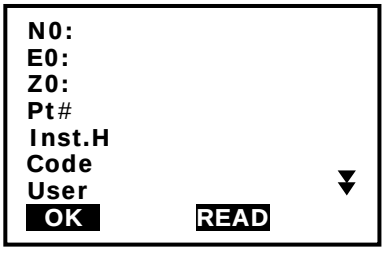
【Procedure of recording occupied data】



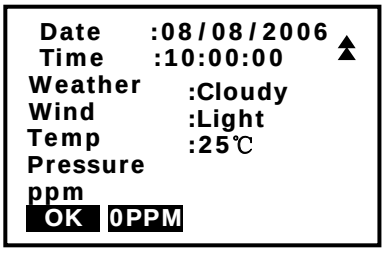
1. Press F3: [**REC**] on P3 in measure mode to enter into record mode. The active JOB will display.



2. Select "**1. Occ. data**" to input data.

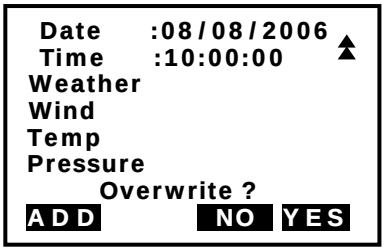


3. Input the following items: N0-E0-Z0, point number, instrument height, code, user, date, time, weather, wind, temperature, pressure, and ppm. Press F2: [**0PPM**] to set ppm value as 0 and the tempressure and pressure as the default value. Press key "▲"/ "▼" to select item and turn page.



4. Press F3: [**READ**] to read existed coordinate data. See " § 6.1 Input the occupied point data".

5. Press F1: [**OK**] to record.

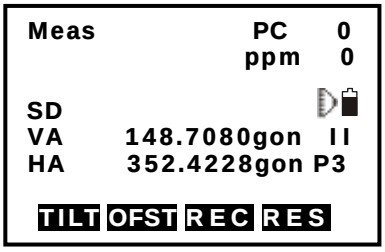


6. If the inputted Pt# is the same as an existed one, the instrument will display as shown left.
Press F3: [**NO**] to re-input;
Press F4: [**YES**] to overwrite;
Press F1: [**ADD**] to save, and the original one will not be deleted.

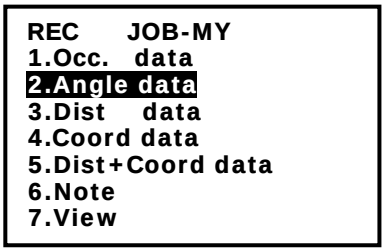
NOTE:

- The max length of Pt# is 14 characters.
- The instrument height range: -9999.999~9999.999.
- The max length of code and user is 16 characters.
- Date and time are not allowed to change here.
- Weather options: Fine, Cloudy, Flurry, Rain, Snow.
- Wind options: Calm, Gentle, Light, Strong, Gust.
- The temperature range: -30 ~ 60℃.
- The pressure range: 500 ~ 1400 hPa（mbar）/ 375 ~ 1050 mmHg /14.8～41.3 inch Hg/ 7.3~20.3 Psi.
- The ppm range: -499 ~ 499 ppm.

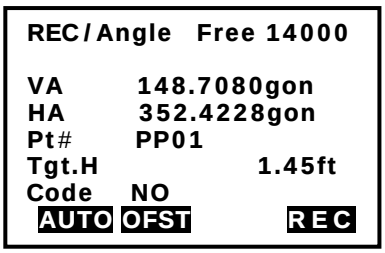
18.2 Record Angle Data



1. Press F3: [**REC**] on P3 in measure mode to enter into record mode. The active JOB will display.



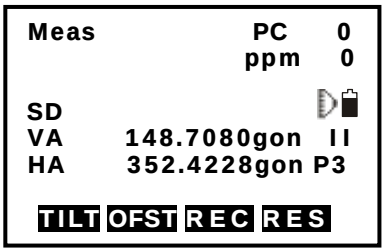
2. Select "**2. Angle data**", then aim at the target, the angle will display in real time.



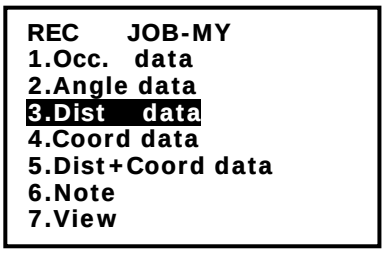
3. Press F4: [**REC**] to input the following items: point number, target height and code, press F1: [**OK**] to save data. Aim at other targets and record them.
You could press F1: [**AUTO**] to perform this process directly if PT#, code and tgt.H are unnecessary to re-set.

18.3 Record Distance Data

【Procedure of recording distance data 】

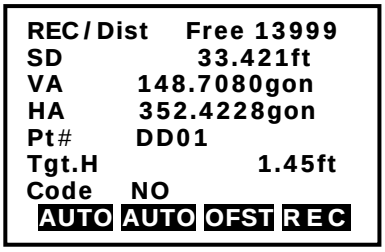


1. Press F1: [**DIST**] on P1 in measure mode to enter into distance measure mode. See " § 6 Distance Measurement"



2. Press F3: [**REC**] on P3 in measure mode to enter into record mode. The active JOB will display.

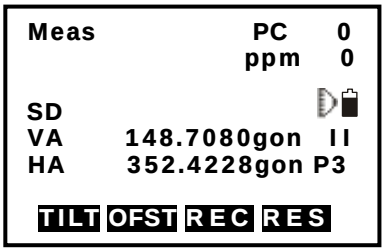
3. Select "**3. Dist data**", the measured data will display.



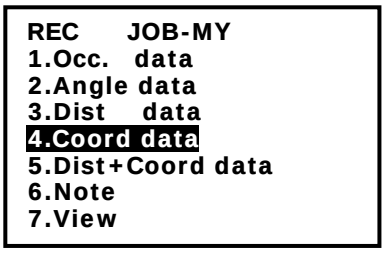
4. Press F4: [**REC**] to input the following items: point number, target height and code, press F1: [**OK**] to save data. Aim at other targets, press F2: [**DIST**] to continue.
You could press F1: [**AUTO**] to perform this process directly if PT#, code and tgt.H are unnecessary to re-set.

18.4 Record Coordinate Data

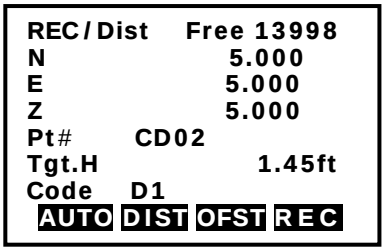
【Procedure of recording coordinate data 】



1. Press F1: [**CORD**] on P1 in measure mode to enter into coordinate measure mode. See " § 6. Coordinate Measurement".
2. Press F3: [**REC**] on P3 in measure mode to enter into record mode. The active JOB will display.



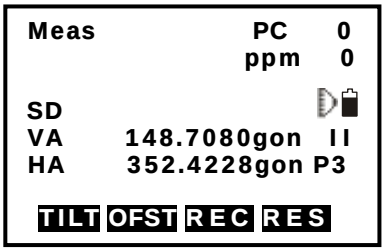
3. Select "**4. Coord data**", the coordinate data will display.



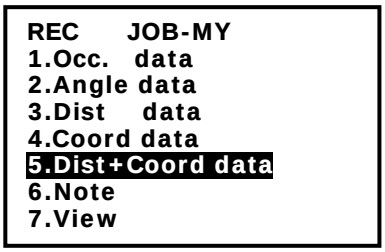
4. Press F4: [**REC**] to input the following items: point number, target height and code, press F1: [**OK**] to save data. Aim at other targets, press F2: [**DIST**] to continue.
You could press F1: [**AUTO**] to perform this process directly if PT#, code and tgt.H are unnecessary to re-set.

18.5 Record Distance&Coordinate Data

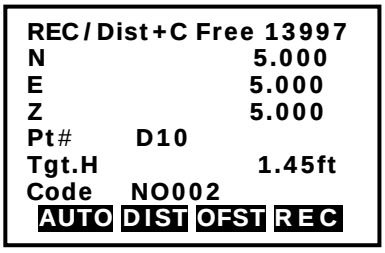
【Procedure of recording distance&ccoordinate data 】



1. Press F3: [**REC**] on P3 in measure mode to enter into record mode. The active JOB will display.



2. Select "**5. Dist+Coord data**".



3. Aim at the target and press F2: [**DIST**] to measure. Press F4: [**REC**] to input the following items: point number, target height and code, press F1: [**OK**] to save data. Aim at other targets, press F2: [**DIST**] to continue.
You could press F1: [**AUTO**] to perform this process directly if PT#, code and tgt.H are unnecessary to re-set.

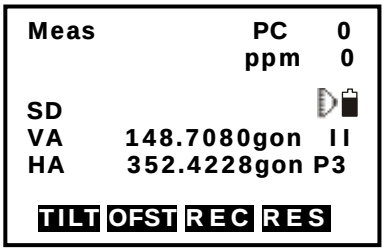
NOTE:

◆ After performing the process once, both distance measurement data and coordinate data are recorded as the same Pt#.

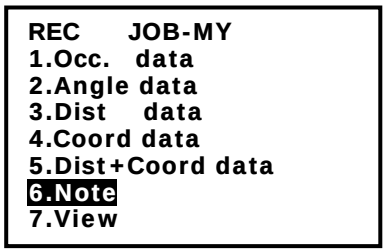
◆ Distance measured data is recorded firstly, and then coordinate data is recorded.

18.6 Record Note

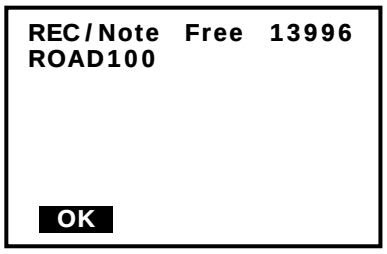
【Procedure of recording note】



1. Press F3: [**REC**] on P3 in measure mode to enter into record mode. The active JOB will display.



2. Select "**6. Note**".



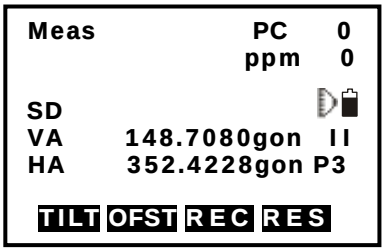
3. Input note and press F1: [**OK**] to save. The max length is 60 characters.

NOTE:

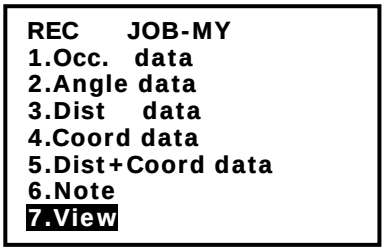
◆ Max note length is 60 characters.

18.7 View Data

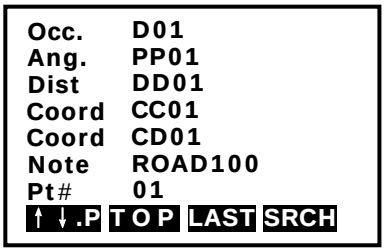
【Procedure of view data 】



1. Press F3: [**REC**] on P3 in measure mode to enter into record mode. The active JOB will display.



2. Select "**7. View**".



3. All recorded data of the active JOB display, select one and press key {ENT} to view. Perform functions on the last line please see " § 6.1 Input the occupied point data". Press key {ESC} back to previous mode.

NOTE:

- If the point number is the same, only the newer recorded data could be viewed.
- The data inputted beforehand could not be viewed here.
- The note could be viewed but its data.

19. JOB Management

19.1 Select a JOB

The active JOB or coordinate search JOB could be selected. The data (known data, measured data, occupied data, coordinates, note, etc) are recorded in the active JOB, and user is able to search and read coordinate in the coordinate search JOB when coordinate measuring, resection or stake out.

NOTE:

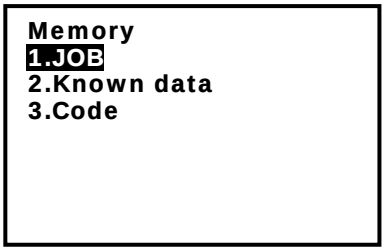
- There are 10 JOBs in total, the fatory default setting is "JOB1".
- The default names are "JOB1","JOB2"…"JOB10", you can rename them if necessary.
- Scale factor could be set for every JOB, but only the one of the active JOB could be modified.

  Here is the equation used to calculate the data:

  HD2=HD1×S.F.

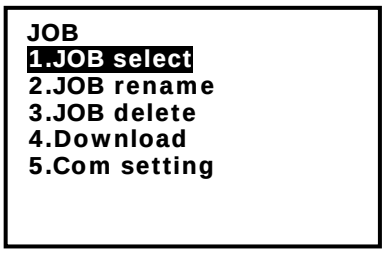
  Where, HD2: corrected horizontal distance
  HD1: measured horizontal distance
  S.F. : scale factor

【Procedure of JOB selection and scale factor setting 】

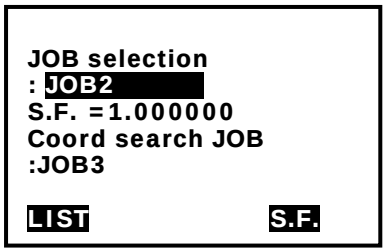


1. Press F3: [**MEM**] in the status mode to enter into memory management.

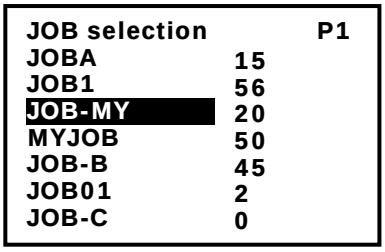
2. Select "**1. JOB**" to enter JOB management.



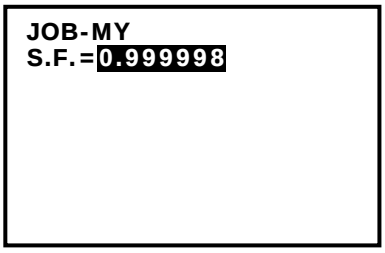
3. Select "**1. JOB select**" to set an active JOB and a coord search JOB.



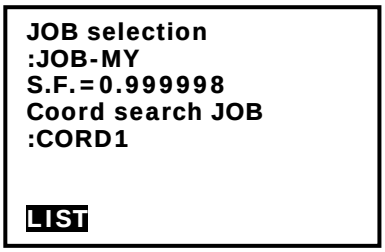
4. Press F1: [**LIST**] to display all JOBs on two pages.
   Press F4: [**S.F.**] to modify the scale factor.



5. Select an active JOB. The numbers to the right represent the number of data itmes in each JOB. Press key {ENT} to save the setting.

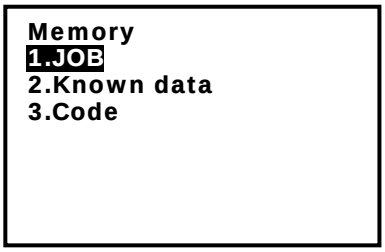


6. Input the sacale fator if necessary. The range: 0.5000000 ~ 2.000000, and the factory setting is 1.000000.



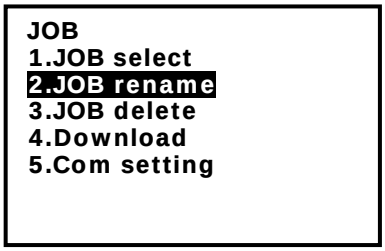
7. Select a coord search JOB following above steps 4 and 5.

19.2 Rename a JOB

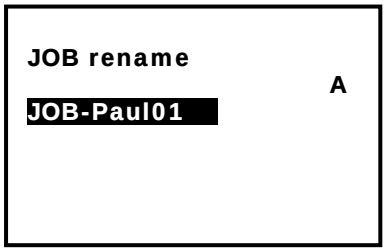


1. Press F3: [**MEM**] in the status mode to enter into memory management.

2. Select "**1. JOB**" to enter JOB management.



3. Select "**2. JOB rename**" to rename the active JOB.

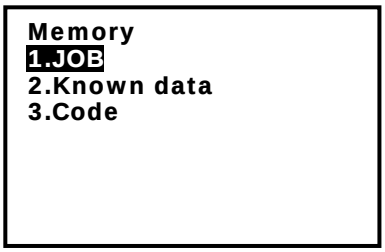


4. Input a new name and press key {ENT} to save the setting. The maximum length of a JOB name is 12 characters.

19.3 Delete a JOB

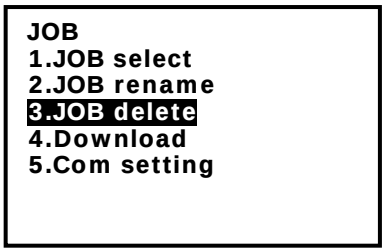
It is possible to delete an existed JOB. Once the JOB has been deleted with the recorded data cleared, the JOB name returns to the default one.

【Procedure of JOB deletion】

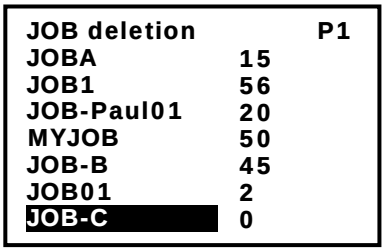


1. Press F3: [**MEM**] in the status mode to enter into memory management.

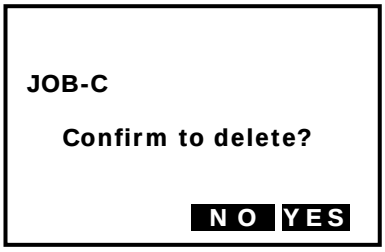
2. Select "**1. JOB**" to enter JOB management.



3. Select "**3. JOB delete**" .



4. 10 JOBs display on two pages. The numbers to the right represent the number of data itmes in each JOB. Select the useless JOB that you wanna delete and press key {ENT}.



5. Press F3: [**NO**] to give up and press F4: [**YES**] to delete the JOB.

19.4 Output JOB Data

Measured data, occupied data, known point data, note and coordinates data existed in all JOBs could be outputted to PC by software.

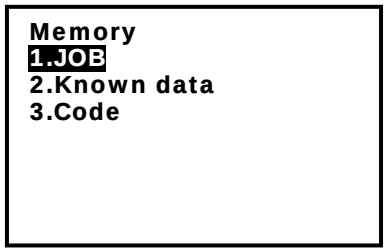
NOTE:

◆ The software is available in your CD-ROM.

◆ Be sure the communication port setting of instrument and PC is the same, see “§ 3.8.3 Communication Port Setting”.

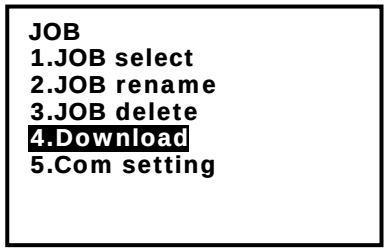
19.4.1 Download data

【Procedure of download】



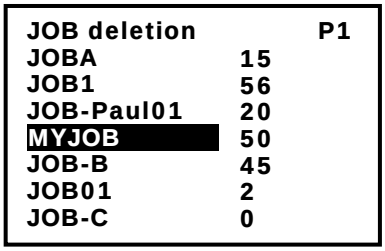
1. Select [**MEM**] in the status mode to enter into memory management.

2. Select “**1. JOB**” to enter JOB management.

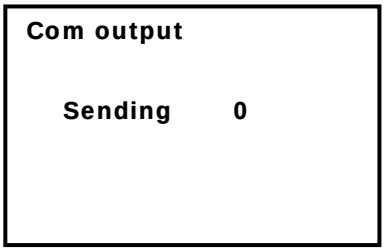


3. Connect your instrument and computer via communication cable (standard component).

4. Select “**4. Download**” to enter into com output mode and all JOBs display.



5. Select the JOB to be output.



6. Press key {ENT} to start to download, it will back to JOB list mode after finishing.

19.4.2 Instruction of Office Program

The data formate:

I. Upload the coordinates data from instrument to computer.

1) Open the COM600 software

2) Click button

Com port: 1

Baud rate: 2400

Parity: NONE

Characters: 8

Stop bits: 1

Protocol: NONE

Click “OK” button to confirm, the software is waiting for data.

3) Set the communication parameters of instrument, it should be the same as the COM600 setting.

4) Select a file, then click button receive to receive data from instrument to PC.

II. Download a list of coordinates from PC to instrument.

(1) Edit a coordinate file, the format is : PT#,X,Y,Z,PCODE

NOTE: a. There is only one comma between them, no blank.

b. The file must be TXT file (*.txt) or DAT file (*.dat).

(2) Click button to set communication parameters, make sure the same as the instrument.

(3) Click button send to send data from PC to instrument.

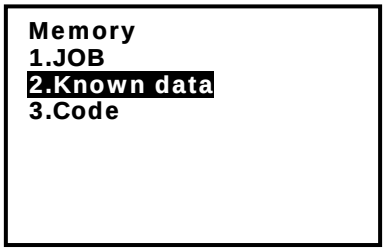
20. Known Data Management

There are 6 items in known data management.

20.1 Input Known Point Coordinate by Keys

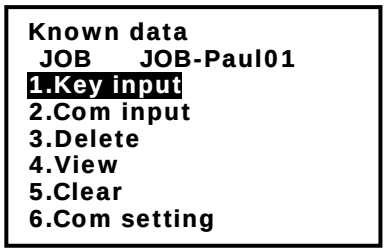
You could input or delete coordinates of known point in the active JOB by key entry or entry from PC. The existed data you have input beforehand could be used as occupied point, backsight point, coordinates of known point or stakeout point. The memory is 16000 points in total.

【Procedure of Inputting known points coordinate】

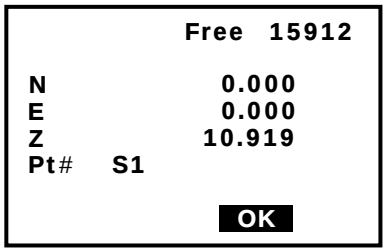


1. Press F3: [**MEM**] in the status mode to enter into memory management.

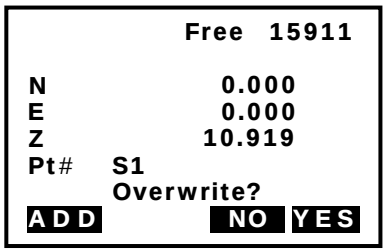
2. Select "**2.Known data**" to enter into known data management. The name of the active JOB will display.



3. Select "**1.Key input**".



4. Input coordinates and point number. The free memory is displayed at the top right corner. Press F3: [**OK**] to save settings and continue. Press key {ESC} back to the known data mode.



5. Once the Pt# is the same as an existed one, it will display as shown left:

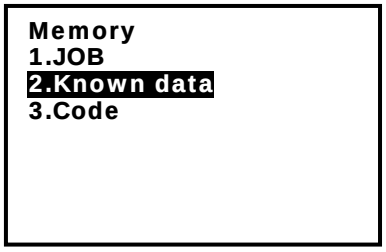
Press F3: [**NO**] to re-input;

Press F4: [**YES**] to overwrite;

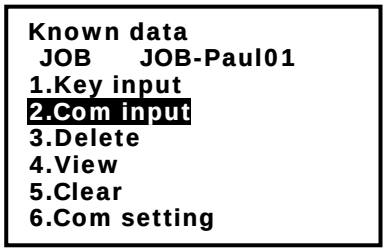
Press F1: [**ADD**] to save, and the original one will not be deleted.

20.2 Input Known Point Coordinate via RS-232C

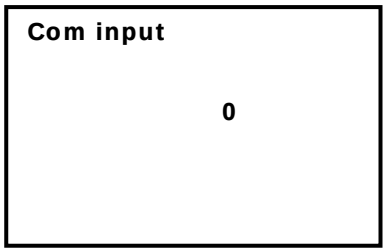
【Procedure of Inputting known points coordinate】



1. Connet instrument and PC via communication cable.
2. Press F3: [**MEM**] in the status mode to enter into memory management.
3. Select "**2.Known data**" to enter into known data management. The name of the active JOB displays.



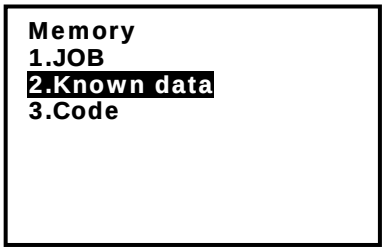
4. Select "**2.Com input**".



5. Open your COM600 software, and click "upload" to perform com setting and select the required text, then begin to send coordinate data.
   It will back to known data mode after finishing.

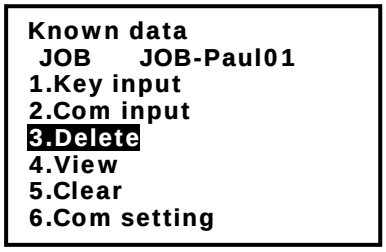
20.3 Delete known point coordinate

【Procedure of known points deletion】

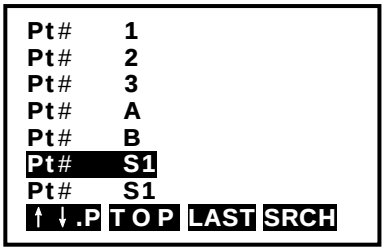


1. Press F3: [**MEM**] in the status mode to enter into memory management.

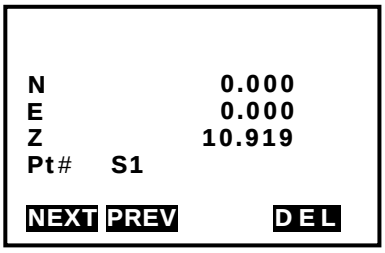
2. Select "**2.known data**" to enter into known data management. The name of the active JOB displays.



3. Select "**3.Delete**" and all points in current JOB will display.



4. Select a point you wanna delete. Perform functions on the last line please see “§ 6.1 Input the occupied point data”.



5. Press F1: [**NEXT**] to display the next point data;

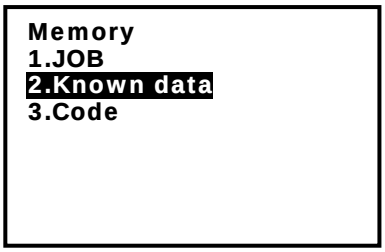
Press F2: [**PREV**] to display the previous point data;

Press F4: [**DEL**] to delete it and continue to delete other points;

Press key {ESC} back to known data management mode.

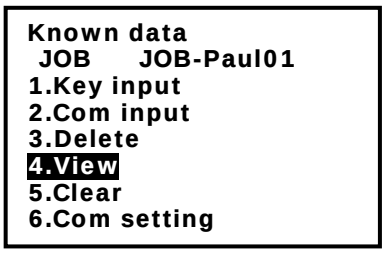
20.4 View known points data

【Procedure of known points view】

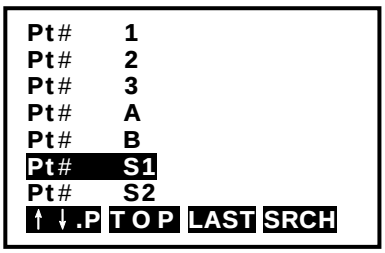


1. Press F3: [**MEM**] in the status mode to enter into memory management.

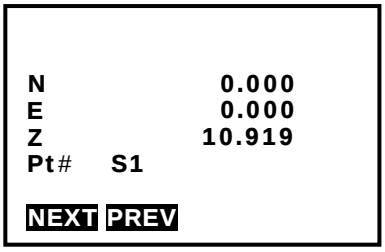
2. Select “**2.known data**” to enter into known data management. The name of the active JOB displays.



3. Select “**4.View**” and all known points of the current JOB will display.



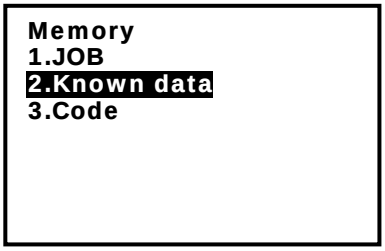
4. Select a required point. Perform functions on the last line, please see “§ 6.1 Input the occupied point data”.



5. The coordinate and point number will display.
Press F1: [**NEXT**] to display the next point data;
Press F2: [**PREV**] to display the previous point data.

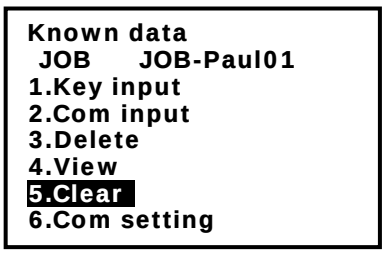
20.5 Clear all known points' data

【Procedure of clearing all known points】

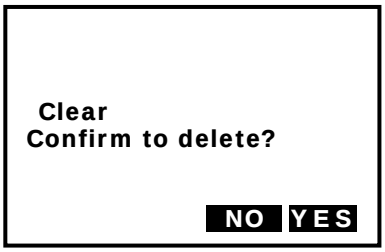


1. Press F3: [**MEM**] in the status mode to enter into memory management.

2. Select "**2.known data**" to enter into known data management. The name of the active JOB displays.



3. Select "**5.Clear**".



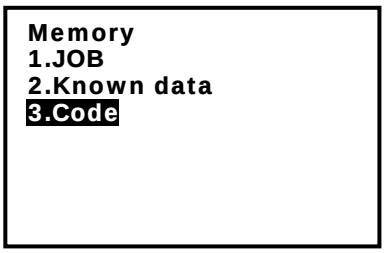
4. Press F3: [**NO**] back to known data management.
Press F4: [**YES**] to delete all known points data of the active JOB completely.

21. Code Management

You could input or delete codes of all JOBs in this mode. All existed codes in memory could be read and the selected code could be recorded together with occupied data or measured data.

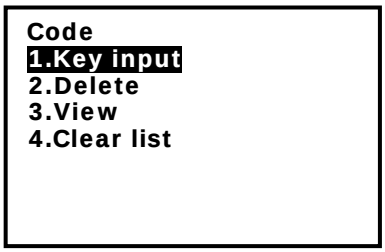
21.1 Input a Code

【Procedure of inputting a code】

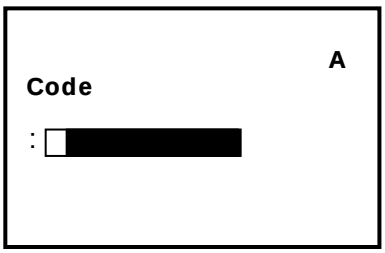


1. Select [**MEM**] in the status mode to enter into memory management.

2. Select "**3.Code**" to enter into code management.



3. Select "**1.Key input**".



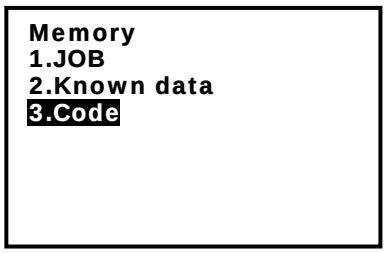
4. Input the code refers to " § 3.6 How to Input Number and Alphabet". Press the key {ENT} to save the code and back to previous mode.

NOTE:

◆ The codes recorded in memory could be read from all JOBs.

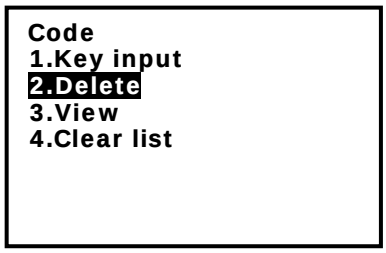
21.2 Delete a Code

【Procedure of deleting a code】

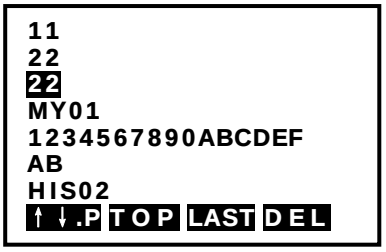


1. Press F3: [**MEM**] in the status mode to enter into memory management.

2. Select "**3.Code**" to enter into code management.



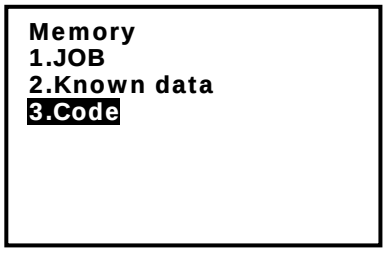
3. Select "**2.Delete**".



4. Select a code you wanna delete. Perform functions on the last line please see " § 6.1 Input the occupied point data". Press F4: [**DEL**] to delete the selected code continuously, or press key {ESC} back to previous mode.

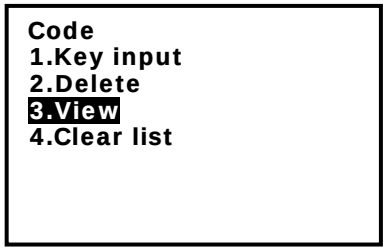
21.3 View All Codes

【Procedure of view all codes】

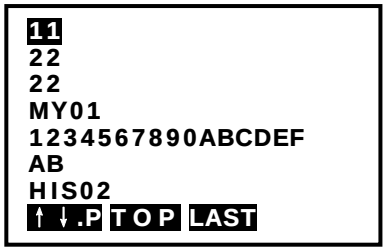


1. Press F3: [**MEM**] in the status mode to enter into memory management.

2. Select "**3.Code**" to enter into code management.



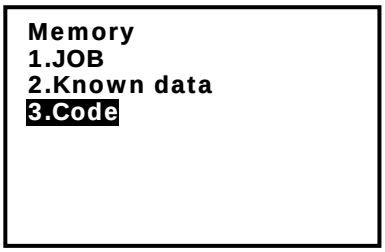
3. Select "**3.View**" to display all codes.



4. Perform functions on the last line please see “§ 6.1 Input the occupied point data”. Press key {ESC} back to previous mode.

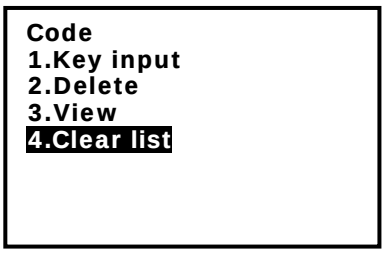
21.4 Clear all Codes

【Procedure of clearing all codes】

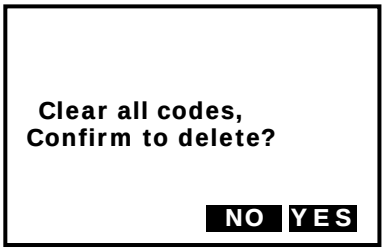


1. Press F3: [**MEM**] in the status mode to enter into memory management.

2. Select “**3.Code**” to enter into code management.



3. Select “**4.Clear list**”.



4. Press F3: [**NO**] back to previous mode;

Press F4: [**YES**] to delete all codes recorded in memory of all JOBs completely.

22. Warning and Error Messages

“Low Signal !”
Please accurately re-sight the target.

“Same coordinates”
The coordinates of the backsights are the same, please re-define or re-input.

“Out of value”
The difference value of coordinates is over range

“Out of range”
The stake out height is over range.

“Need 1st obs”
During missing line measurement, the observation of the starting position was not completed normally. Sight the starting position accurately and press [**OBS**] to perform the measurement again.

“Change 1st obs?”
During missing line measurement, the observation of the target was not completed normally. Sight the target accurately and press [**MLM**] to perform the measurement again.

“Need prism obs”
During REM measuring, the observation of the target was not completed normally. Sight the offset point accurately and press [**MEAS**] to perform the measurement again.

“No Free Space!”
There is no more space to enter data. Record the data again after deleting unnecessary data from the JOB or coordinate data from memory.

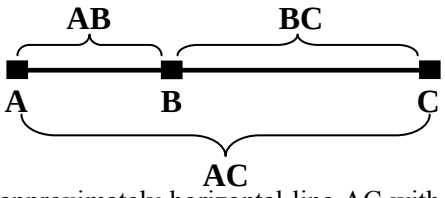
“No data”
When searching for coordinate data or searching for code data, the search stopped either because the item in question does not exist or the data volume is large.

23. Check and Adjustment

23.1 The Instrument Constant

Ⅰ. Check

It is suggested to observe and compare the instrument with a testing baseline which is set on stable ground with a particular accuracy, though error is not generally included in the instrument constant. If the testing line is unavailable, you can select a flat place and set up the instrument and a target in the same height.



1. Select a point B on the approximately horizontal line AC with about 100 meters long. Measure the distances of lines AB , AC and BC .

2. The instrument constant can be calculated;

instrument constant =AB+BC-AC

3. Repeat steps 1 and 2 ten times, and get the average value for instrument const, if the average value is within ±3mm, adjustment is unnessary.

4. If the difference is over ±3mm after the preceding operations, it is necessary to reset the instrument constant .

Ⅱ. Adjustment

If the instrument const is necessary to reset, please contact FUJIYAMA service representative to perform that.

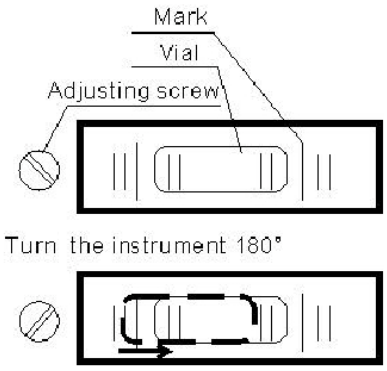
23.2 Tubular Level

Ⅰ. Check

1. Mount the instrument on a stable device (as tripod, adjusting device), and fix it.
2. Level the instrument until the plate level is parallel to a line linking leveling foot screws A and B, then adjust the two screws to center the bubble.
3. Turn the instrument 180°/200gon, observe the moving direction of the bubble, if it is still centered, no adjustment is necessary, if not, you have to adjust it.

Ⅱ. Adjustment

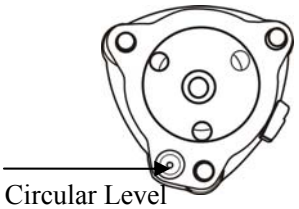
1. Mount the instrument on a stable device and fix it.
2. Level it roughly.
3. Turn the instrument and make the tubular level be parallel to a line linking two leveling foot screws, then adjust the two screws to center the bubble.
4. Turn the instrument 180°/200gon, adjust the Adj-screw with adjustment pin slightly to correct half of the bubble's displacement when it doesn't move,
5. Repeat operations 3, 4 until the bubble remains centered in any position.



23.3 Circular Level

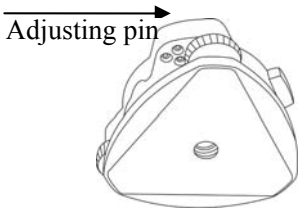
Ⅰ. Check

1. Mount the instrument on a stable device and fix it.
2. Level it accurately by the plate level.
3. Observe the bubble of the circular level, if it is centered, no adjustment is necessary, if not, you have to adjust it.



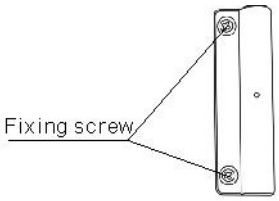
Ⅱ. Adjustment

1. Mount the instrument on a stable device and fix it.
2. Level it accurately by the plate level.
3. Adjust the three adj-screws to center the bubble by a wrench.



NOTE: Be careful when adjusting the three screws, and the tightening tension is identical for them.

23.4 The Optical Sight



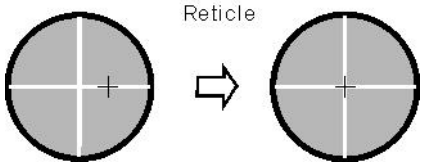
Ⅰ. Check

1. Mount the instrument on a tripod and fix it.

2. Set a cross mark target which apart from the instrument about 50m.

3. Take the telescope sight the cross mark.

4. Observe the optical sight collimator whether collimating the cross mark, if collimate the mark, adjustment is not necessary; if not, adjust it.



Ⅱ. Adjustment

1. Mount the instrument at the tripod and fix it.

2. Set a cross mark target which apart from the instrument about 50m.

3. Take the telescope sight the cross mark.

4. Loosen two fixing screws, adjust the collimator, then fix the two screws again.

23.5 Optical Plummet

Ⅰ. Check

1. Mount the instrument at the tripod and fix it.

2. Set a cross mark under the instrument

3. Coincide the center mark of the optical plummet with the cross mark by adjusting three leveling foot screws.

4. Turn the instrument 180°/200gon, check the center mark and cross mark, if they are coincide, no adjustment is necessary, if not, adjust it.

Ⅱ. Adjustment

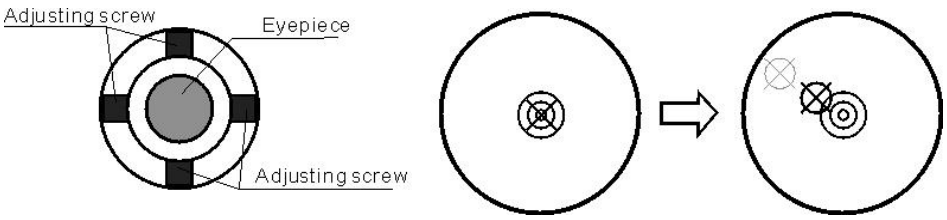
1. Set the instrument on stable device and fix it.

2. Set a cross mark under the instrument.

3. Use the three leveling screws and coincide the center mark of plummet and cross mark on the ground.

4. Rotate the instrument 180°/200gon around and take off the cover of the optical plummet eyepiece, adjust the four adjusting screws with the adjusting pin to shift the center mark to the cross mark, correct only one-half of the displacement in this manner.

(5) Repeat the operation in (3) and (4) until coincide the center mark of the plummet and cross mark on the ground.



NOTE: When adjust the screws of plummet reticle, firstly loosen the screw on the moving direction of reticle, secondly tighten another screw by the same mount, clockwise turning is for tightening, and anticlockwise turning is for loosening, the turning mount for tightening or loosening should be same.

23.6 Laser Plummet (optional)

Ⅰ. Check

(1) Set the instrument on stable device and fix it;

(2) Set a cross mark on the ground under the instrument;

(3) Turn the three leveling screws until the instrument keeps leveling and the laser spot coincides with the cross mark on the ground;

(4) Rotate the instrument 180°(200gon) around and check the laser spot and cross mark，if they are coincide, adjustment is not required. Otherwise, adjust it.

Ⅱ. Adjustment

(1) Set the instrument on stable device and fix it;

(2) Set a cross mark on the ground under the instrument;

(3) Turn the three leveling screws until the instrument keeps leveling and the laser spot coincides with the cross mark on the ground;

(4) Rotate the instrument 180°(200gon) around and take off the protecting cover of the laser plummet, adjust the four adjusting screws with the screwdriver to move the laser spot to the cross mark, correct only one-half of the displacement in this manner.

(5) Repeat operation 3, 4 until the instrument keeps leveling and the laser spot coincides with the cross mark when rotating alidade of instrument to any direction.

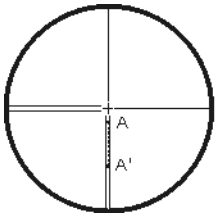
23.7 Vertical Cross-hair on Telescope

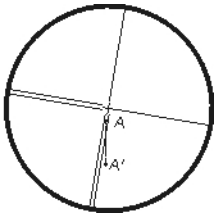
Ⅰ. Check

(1) Set the instrument up the tripod and carefully level it.

(2) Set a point A front the instrument 50m apart;

(3) Collimate the point A and adjust the vertical tangent screw; If the point appears to move continuously on the hair, adjustment is not required. Otherwise, adjust it.





Ⅱ． Adjustment

(1) Set the instrument, and set the point A front the instrument 50m apart.

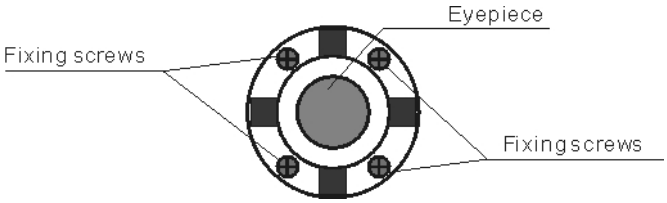
(2) Take off cover of telescope eyepiece, there are 4 screws for the reticle part.

(3) Loosen all four fixing screws slightly with the cross screw-driver.

(4) Revolve the eyepiece section so that the vertical cross-hair coincides to point A, finally, re-tighten the four screws.

(5) Repeat the checking and adjusting until there is no deviation.

NOTE: After the adjustment of cross-hair, please check the collimation error and vertical index error, see “§27.11 EDM Optical Axis and the Telescope Sighting Axis Error”.



23.8 Horizontal Collimation Error C

If the telescope’s sight line isn’t perpendicular to the horizontal axis, the collimation error will appear. The assembling, transportation and operation will cause this error.

Ⅰ． Check

(1) Set-up the instrument on tripod or adjustment platform and leveling accurately.

(2) Aim at the cross-hairs of collimator or the obvious target at a distance. Gets the face left angle reading H1 and the face right angle reading Hr.

(3) Calculating the horizontal collimation error C according to C=（Hl- Hr±180°）/2, if C<8″, no adjustment will be necessary. If C>8″, proceed with the following adjustment.

Ⅱ． Adjustment

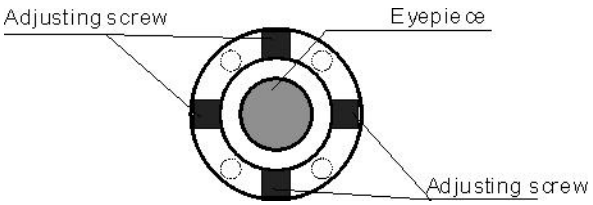
(1) Power on the instrument after leveling-up, and rotate telescope to initial.

(2) Aim at the cross-hairs of collimator or the obvious target at a distance. Gets the face left angle reading H1 and the face right angle reading Hr.

(3) Rotate the instrument in face right position, turning horizontal tangent screw until Hr′=Hr+C.

(4) Loosen the shield of telescope’s reticle. Adjusting two screws at left and at right until the vertical hairs of telescope’s reticle coincides with the cross-hairs of collimator or target.

(5) Repeat the check and adjustment procedure until the error is accepted.



NOTE:

1. When adjusting the screws of reticle, firstly loosen the screw on the moving direction of reticle, secondly tighten another screw by the same mount, clockwise turning is for tightening, and anticlockwise turning is for loosening, the turning mount for tightening or loosening should be same.

2. After the reticle adjustment, it is necessary to adjust the vertical index error by program, see " § 23.10 Vertical Index Error".

23.9 Tilt Sensor

If the tilt angle shown on the display shifts from tilt angle 0° (zero point), the instrument is not correctly leveled. This will adversely affect angle measurement. Perform the following procedures to cancel the tilt zero point error.

Ⅰ. Check

Set-up the instrument on tripod or adjustment platform, and level it accurately.

```
Config
1.Meas condition
2.Inst config
3.Inst adjust
4.Com setting
5.Unit
6.Date & Time
```

1. Press F3: [**0SET**] twice to set HA to 0° on P1 in measure mode.

Press key {Cnfg} to enter into config mode.

2. Select "**3.Inst adjust**" to set instrument basic parameters, two items display.

```
Inst adjust
1.Tilt correct
2.Index error correct
```

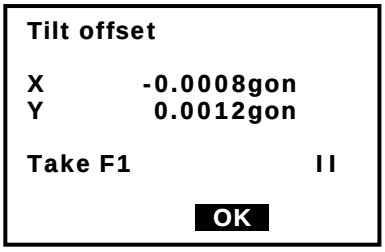
3. Select "**1. Tilt correct**".

```
Tilt offset

X        -0.0020gon
Y         0.0032gon
  HA   127.1202gon
Take F1              I

            OK
```

4. Wait a few seconds for this display to stabilize, then read the automatically compensated angles X1 and Y1.



5. Rotate the instrument 180° /200gon. Loosen the horizontal clamp and turn the instrument 180° /200gon while referring to the displayed horizontal angle, then re-tighten the clamp. Wait a few seconds for the display to stabilize, then read the automatically compensated angles X2 and Y2.

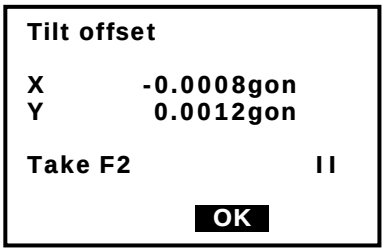
Calculate the following offset values (tilt zero point error):

Xoffset= (X1+X2)/2

Yoffset= (Y1+Y2)/2

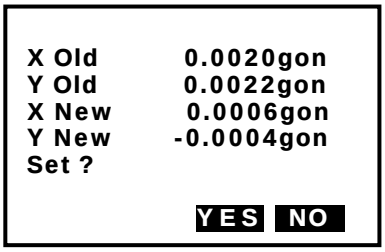
When the offset value falls within the range ±20″, adjustment is not necessary. If one of the offset values (Xoffset, Yoffset) exceeds ±20″, adjust the value as follows.

Ⅱ. Adjustment



6. Press F3: [**OK**] to set the horizontal angle to 0° , "Take F2" is displayed.

7. Rotate the top of instrument 180° /200gon. Wait a few seconds for the display to stabilize, then press F3: [**OK**].



8. If both correction constant are in the range, press F3: [**YES**] to renew the correction angle, or press F4: [**NO**] to give up this adjustment,

23.10 Vertical Index Error

The deviation between vertical circle zero position and horizontal direction is vertical index (i), it is necessary to concern this error when measure vertical angle. The instrument program applied a formula to correct this error.

Warning: Before starting this operation, be sure to read this manual carefully, otherwise it may cause data faulty.

Because of the close relationship between vertical index and compensator zero position, it is necessary to check and adjust compensator zero position before adjusting vertical circle, the value should be stable when reading.

Ⅰ. Check:

Please adjust the reticle of telescope and correct the collimation error before this operation.

(1) Mount the instrument at the tripod or a stable device and level it accurately, then turn on the instrument.

(2) Aim at the cross-hairs of collimator or the obvious target at a distance, VA should be about ±10°. Read the face left angle Vl and face right angle Vr.

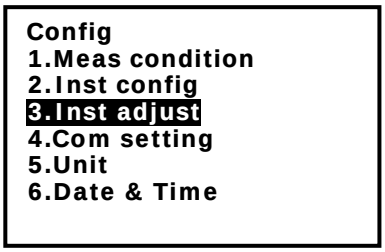
(3) Calculate the index error according to the formula below:

$$i = (Vl+Vr-360°)/2$$

(4)If I<10″ , no adjustment is necessary , or you have to adjust it .

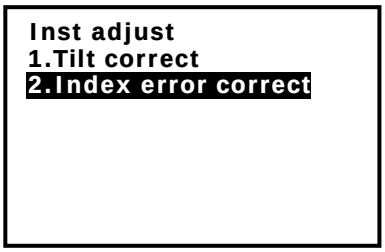
Ⅱ. Adjustment by program:

Set-up the instrument on tripod or adjustment platform, and level it accurately.

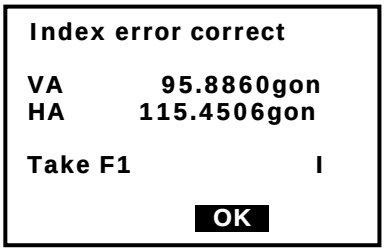


1. Press key {Cnfg} to enter into config mode.

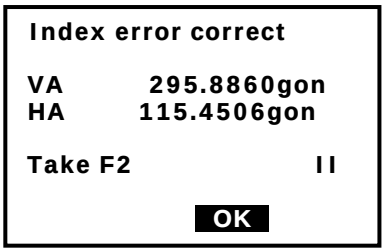
2. Select "**3.Inst adjust**" to set instrument basic parameters. Two items display.



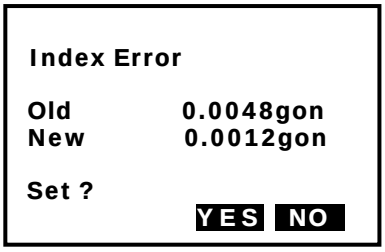
3. Select "**2.Index error correct**".



4. Sight a reference point in face I and press F3: [**OK**].



5. Sight the reference point in face II. Rotate the instrument 180° /200gon and sight the same point, then press F3: [**OK**].



6. Press F3: [**YES**] to set the correction, and press F4: [**NO**] to give up.

23.11 EDM Optical Axis and the Telescope Sighting Axis Error

It is necessary to check this error after the adjustment of telescope reticle error.

Ⅰ. Check (For FY TS 682/685)

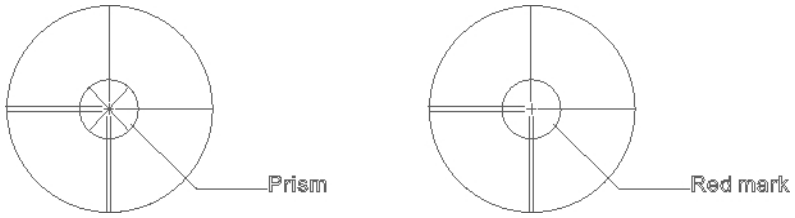
(1)Install the instrument at the tripod or a stable device and level it accurately, then turn on the instrument's power on.

(2) Set a prism about 2m far away from the instrument.

(3) Aim at the prism center with telescope reticle

(4) Enter EDM signal testing screen, see " § 4.7 Setting Mode".

(5) Observe through eyepiece, turn the focusing knob until the read mark is clear, if the deviation between mark and cross-hair is not over 1/5 of red mark diameter, adjustment is unnecessary.



Ⅱ. Check (For FY TSO 682/685)

(1) Install the instrument at the tripod or a stable device and level it accurately, then power on the instrument.

(2) Set a reflective sheet about 5m-20m far away from the instrument.

(3) Aim at the sheet cross-mark with telescope reticle.

(4) Enter EDM signal testing screen, see “ § 4.7 Setting Mode”.
(5) Observe the laser spot, if the laser spot coincides with the cross-mark of reflective sheet, adjustment is unnecessary.

NOTE:
1. Laser radiation—Avoid direct eye exposure.
2. If the instrument needs adjustment, please contact your local dealer.

24. Specifications

FY TS 682/685

Telescope

Length	156mm
Image	Erect
Objecttive aperture (EDM)	Φ45mm
Magnification	30×
Field of view	1°20′
Resolving power	3.5″
Mini focus distance	1.1m

Angle measurement

Reading system	Absolute encoder	
Circle diameter	79mm	
Angle unit	degree/gon/mil, selectable	
Minimum display	1″/ 5″/10″, selectable	
	0.0001°/0.0005°/0.001°, selectable	
	0.2mgon/1mgon/2mgon, selectable	
Detecting mode	Horizontal angle: double	
	Vertical angle: double	
Accuracy	FY TS 682	2″
	FY TS 685	5″

Distance measurement

Distance unit	m/ft, selectable	
Measurement range(good condition)	Single prism	1 to 2000m
	Three prisms	1 to 2500m
Mini-reading	Fine mode	1mm(0.01ft)
	Tracking mode	10mm (0.1ft)
Accuracy	±(2mm＋2ppm·D)	
Measurement time	Fine mode: 1.7 s	
	Tracking mode: 0.7 s	
Temperature unit	℃/℉, selectable	
Pressure unit	hPa/mmHg/inchHg, selectable	
Temperature input range	-30℃ to +60℃ (1℃ steps)	
Pressure input range	510hPa to 1066hPa(1hPa setps)	
Prism constant condition	-99.9mm ~ +99.9mm	
Refraction and earth curvature correction	OFF/0.14/0.2, selectable	
Reflecting prism constant correction	-99.9mm to +99.9mm	

Level vial sensitivity

Plate level	30″ / 2mm
Circular level	8′ / 2mm

Compensation

System	Liquid dual axis
Range	±3′
Resolving power	1″

Optical plummet

Accuracy	±0.8mm/1.5m
Image	Erect
Magnification	3×
Focusing range	0.5m～∝
Field of view	4°

Laser plummet (Factory optional)

Accuracy	±0.8mm/1.5m
Laser class	Class 2/IEC60825-1
Focus range	0.5m～∝
Laser wave length	635nm

Display

LCD	8 lines×24 characters
Illumination	Yes

Internal memory

Internal memory	16000 points

Data communication

I/O	RS-232C

Power

Battery	2200 mAh Ni-MH Rechargeable battery
Voltage	7.2V DC
Continuous operation tine	Approx. 8 hours Distance/angle measurement Approx. 20 hours Angle measurement
Chargers	FDJ6 (100V to 240V 50/60Hz)
Charging time (at +20℃)	Approx. 4 hours

Others

Working temperature	-20°～+50℃
Dimension	220×184×360mm(W×D×H)

Weight	6kg
Water proof	IP54 (IEC60529)

FY TSO 682/685

Telescope

Length	156mm
Image	Erect
Objective aperture (EDM)	Φ45mm
Magnification	30×
Field of view	1 °20′
Resolving power	3.5″
Mini focus distance	1.7m

Angle measurement

Reading system	Absolute encoder
Circle diameter	79mm
Angle unit	degree/gon, selectable
Minimum display	1 ″/ 5 ″/10″, selectable
	0.0001°/0.0005°/0.001°, selectable
	0.2mgon/1mgon/2mgon, selectable
Detecting mode	Horizontal angle: double
	Vertical angle: double
Accuracy	FY TSO 682 2 ″
	FY TSO 685 5 ″

Distance measurement

Laser wave length	650-690nm
Laser class	Class 3R (IEC 60825-1)
Measurement range (good condition)	
Reflectorless	1 to 150m(White target/KODAK CAT No.:E1527759)
Reflective sheet/RP30	1 to 500m
Reflective sheet/RP60	1 to 800m
Single prism	1 to 5000m
Mini-reading	Fine mode 1mm (0.01ft)
	Tracking mode 10mm(0.1ft)
Accuracy	
Prism mode	±(2mm＋2ppm·D)
Reflectorless mode	±(3mm＋3ppm·D)
Measurement time	Fine mode: 1.2sec.
	Tracking mode: 0.5 sec.
Distance unit	m/ft, selectable
Temperature unit	℃/℉, selectable
Pressure unit	hPa/mmHg/inchHg, selectable

Temperature input range	-30℃ to +60℃ (1℃ steps)
Pressure input range	510hPa to 1066hPa(1hPa setps)
Prism constant condition	-99.9mm to +99.9mm
Refraction and earth curvature correction	OFF/0.14/0.2, selectable
Reflecting prism constant correction	-99.9mm to +99.9mm

Level vial sensitivity

Plate level	30″ / 2mm
Circular level	8′ / 2mm

Compensation	Dual-axis
System	Liquid type
Range	± 3′
Resolving power	1″

Optical plummet

Image	Erect
Magnification	3×
Focusing range	0.5m～∝
Field of view	4°

Laser plummet

Accuracy	±0.8mm/1.5m
Laser class	Class 2/IEC60825-1
Focusing range	0.5m～∝
Laser wave length	635nm

Display

LCD	8 lines×24 characters

Internal memory

Internal memory	16000 points

Data communication

I/O	RS-232C

Power

Battery	2200mAh Ni-MH Rechargeable	
battery		
Voltage	7.2V DC	
Continuous operation tine	About 8 hours	Distance/angle measurement
	About 20 hours	Angle measurement

Chargers	FDJ6 (100V to 240V 50/60Hz)
Charging time (at +20℃)	Approx. 4 hours

Others

Working temperature	-20°～+50℃
Dimension	220×184×360ｍｍ(W×D×H)
Weight	6kg
Water proof	IP54 (IEC60529)

25. Accessories

- Carrying case 1 pcs
- Battery 2 pcs
- Charger 1 pcs
- Adjusting pins 2 pcs
- Cleaning cloth 1 pcs
- Screwdriver 1 pcs
- Wrench 1 pcs
- Silica gel 1 pcs
- Certification 1 pcs
- Packing list 1 pcs
- Instruction manual 1 pcs
- CD-ROM 1 pcs
- RS-232C Communication cable 1 pcs
- Reflective sheet/RP30 4 pcs (only for FY TSO 680 series)
- Reflective sheet/RP60 1 pcs (only for FY TSO 680 series)
- Laser caution sign board 1 pcs (only for FY TSO 680 serie)s)

Appendix I: Atmospheric correction formula and chart (Just for reference)

Factory setting: temperature: 20℃, pressure:1013hPa, 0ppm

The correction:

Kpt＝274.417-0.2905*p/(1＋0.0036*t)……..FT TS 682/685

Kpt＝278.960-0.2902*p/(1＋0.0036*t)……. FT TSO 682/685

Where: p--Pressure value (hPa)

t--Temperature value (℃)

Kpt--Atmospheric correction (ppm)

Example:

t=20℃, p=1013hpa, L0=1000m.

Then: Kpt=0ppm (FT TS 682/685)

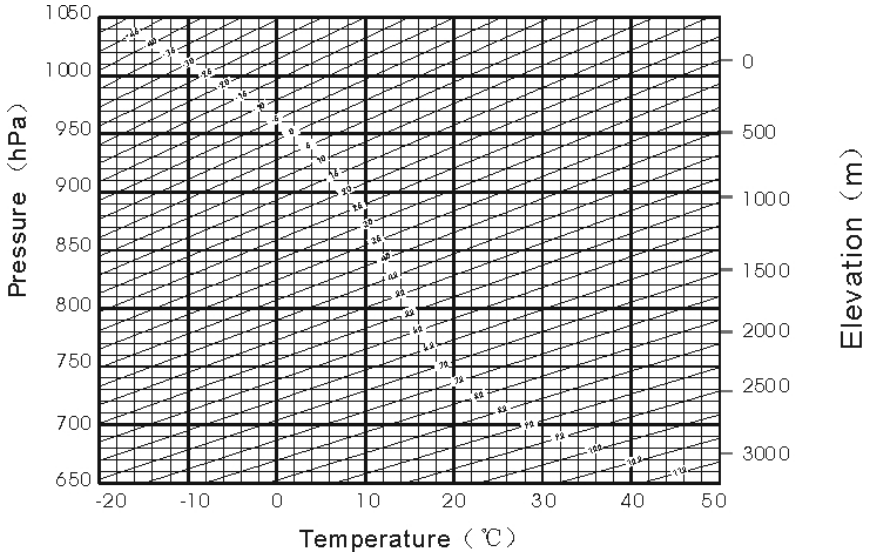
Kpt=4ppm (FT TSO 682/685)

L=L0(1+Kpt)=1000×(1+0×10-6)=1000.000m (.FT TS 682/685)

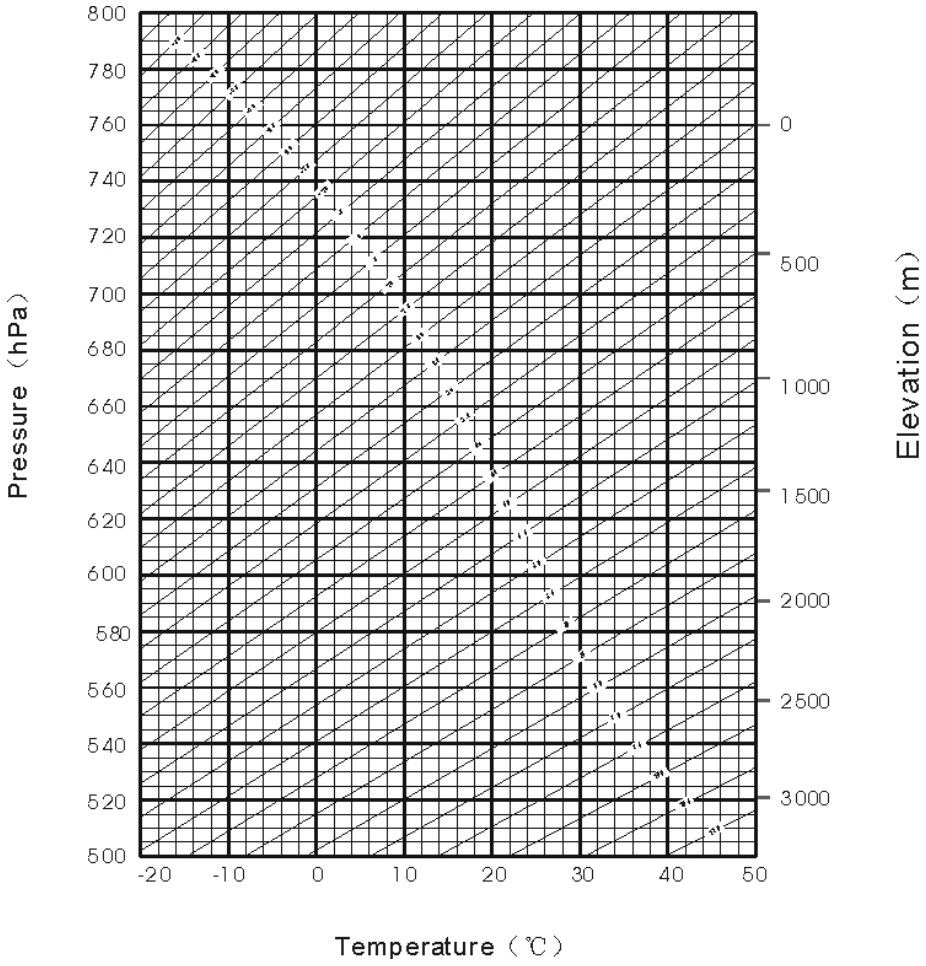
L=L0(1+Kpt)=1000×(1+4×10-6)=1000.004m (FT TSO 682/685)

The atmospheric value is obtained easily with the atmospheric correction chart. Find the measured temperature in horizontal axis, and pressure in vertical axis on the chart.

Read the value from the diagonal line, which is the required atmospheric correction value.



For FY TS 682/685



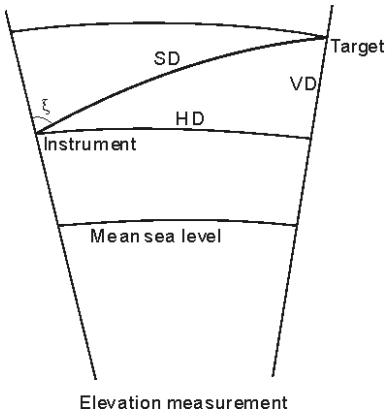
For FY TSO 682/685

Appendix Ⅱ：Correction for refraction and earth curvature

Considering the correction of refraction and earth curvature for distance measurement, the formula for slope distance, horizontal distance and vertical distance applied in the instrument are as followings:

$SD=D_0\times(1+ppm\times10^{-6})+mm$

SD－－Displayed slope distance（m）
D_0－－Real measured distance（m）
ppm－－Scale coefficient（mm/km）
mm－－Target constant (mm)



Elevation measurement

$HD=Y-A\times X\times Y$
$VD=X+B\times Y^2$

HD－－Horizontal distance（mm）
VD－－Vertical distance（mm）
$Y = SD.|\sin\zeta|$
$X = SD.\cos\zeta$
ζ －－Zenith angle

$$A=\frac{1-K/2}{R}$$

$$B=\frac{1-K/2}{2R}$$

K = 0.142 or 0.20
$R = 6.37\times10^6$（m）

The conversion formula for horizontal and vertical distance is as follows when correction for refraction and earth curvature is not applied:

HD=SD COS §　　VD=SD ｜SIN § ｜

NOTE:

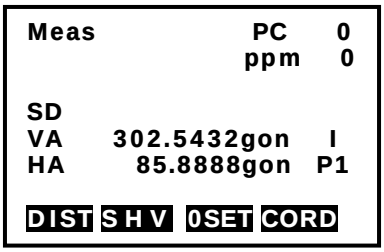
◆ The factory setting for the refraction coefficient K is 0.142.

Refer to the “§3.8.1 Measure Condition Setting” to change the value.

Appendix III：Connect the FY TS 680/TSO 680 series with PDA

1. Connect the 680 series and PDA(Here we will take Carlson Explorer as a example) with RS-232C cable

2. Refer to the chapter 3.8.3 Communication Port Setting to set the parameters on 680 series. And then set the instrument at basic measurement mode, as followings shown:



3. Run the survey program on the PDA, for example, SurvCE.exe of Carlson, then select the instrument mode in the SurvCE.

NOTE: "Sokkia Set" for 680 series is available.

4. Set the communication parameters on the PDA, they must be same with 680 series's. And select the "2-Way" in communication setting.

5. And then the PDA will sending data to 680 series to test the communication, if they can not communication, check the cable connection and parameters to try again.

NOTE:

These designs, figures and specifications are subject to change without notice. We shall not be held liable for damages resulting from errors in this instruction manual.